THE...HUG WATER WHEEL

1512-14 Blake St.
DENVER, COLO.

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THE HUG

WATER WHEEL

Patented in the United States and Foreign Countries.

* * *

MANUFACTURED ONLY BY

D. HUG,

DENVER, COLORADO.

* * *

Cable Address, "Hug, Denver."
Use Code.

1901

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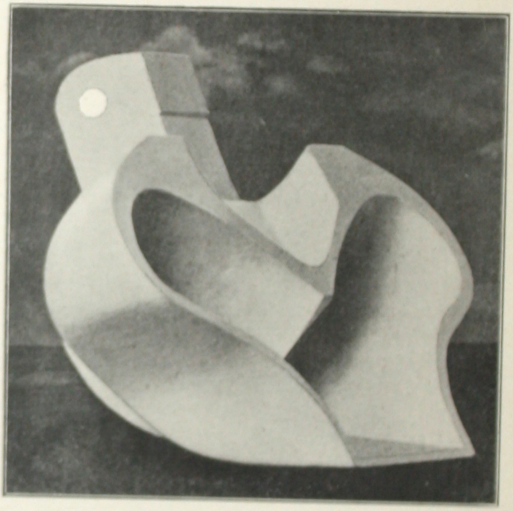

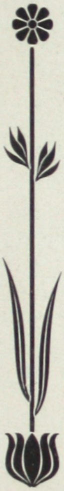

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WE would respectfully call the attention of those interested in the development of water power to the merits of THE HUG WATER WHEEL as set forth in the following pages.

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SPECIAL ATTENTION is called to pages 9 and 11 which contain a report of careful tests on this wheel made by Prof. R. C. Carpenter of Cornell University.

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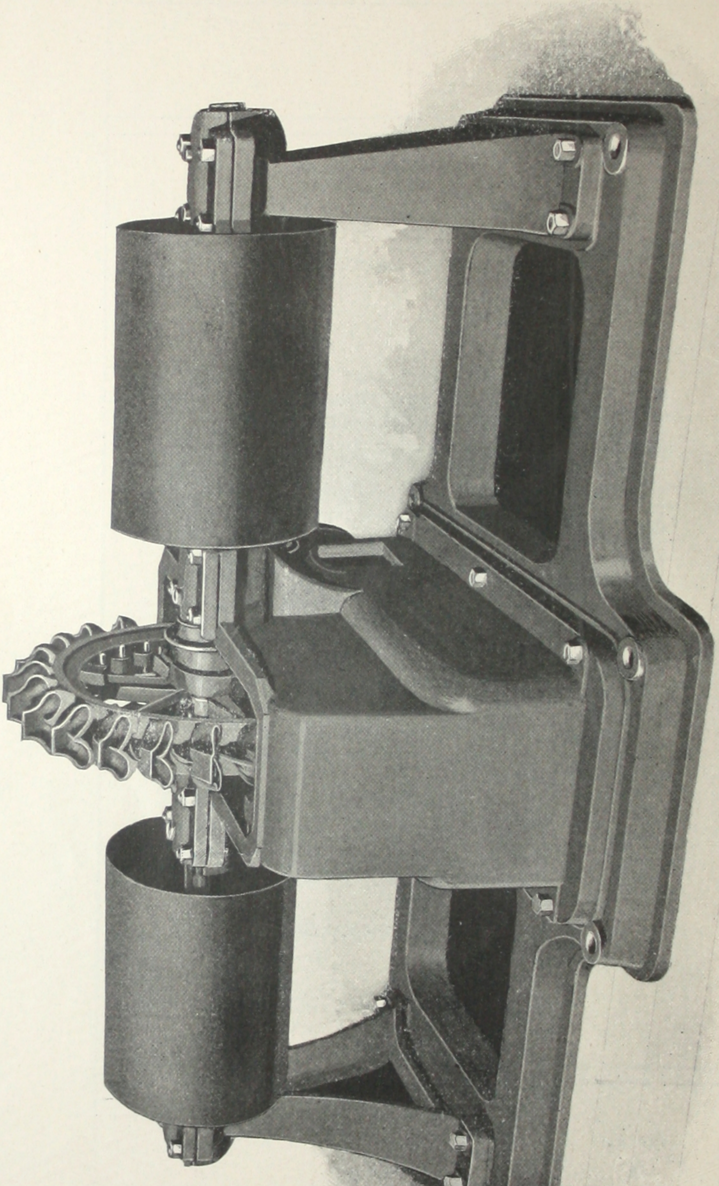
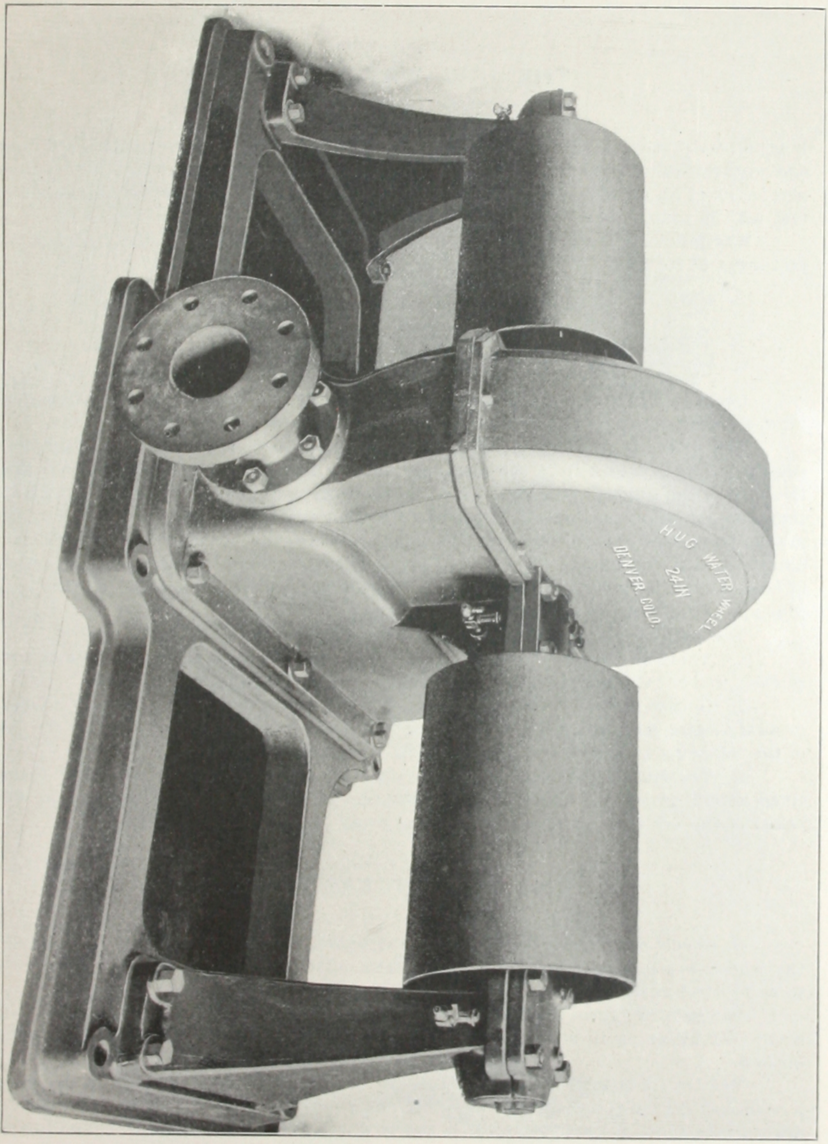


24 inch Motor for high head and heavy work, with cover removed. Wheel and Buckets in Tropenas Cast Steel.



The same as on page 4 with cover in place.

THE HUG WATER WHEEL

Is of the well-known "Tangential Impulse" type, but by reason of its excellence of design and workmanship, it has proven itself far superior, not only under the carefully arranged provisions of an efficiency test, but also under the trying and widely varying conditions met with in practical service.

The following features are peculiar to this wheel, and serve to distinguish it from all others of its class:

THE BUCKET

On page 2 is shown a full-size view of a Hug Bucket, and on page 7 an assembled view, showing wheel, buckets, nozzle, and case, in their proper relative positions.

The direction of the water during its passage through the bucket is completely reversed; and it issues from the discharge ears in such a manner that **it cannot** strike the back of the following bucket. The peculiar form of the bucket channels is such that they present an exceedingly small area of wetted surface, which, together with their gradual curvature throughout, serves to greatly reduce the ordinary losses of efficiency due to friction and impact. The loss in this bucket by a stream reduced to 25 per cent. of bucket capacity is 6½ per cent. less than on the best bucket so far known. The result of shape of the Hug Bucket.

The following points are advantageous beyond question:

1. There is no other bucket that reverses the stream so completely as the **Hug** Bucket, without the possibility of striking the back of the one next following.

2. In case of accidental overloading, the **Hug** Wheel does not lose speed as quickly as the other wheels, and because of the impossibility of any water striking the back of the following bucket, it recovers its speed more quickly.

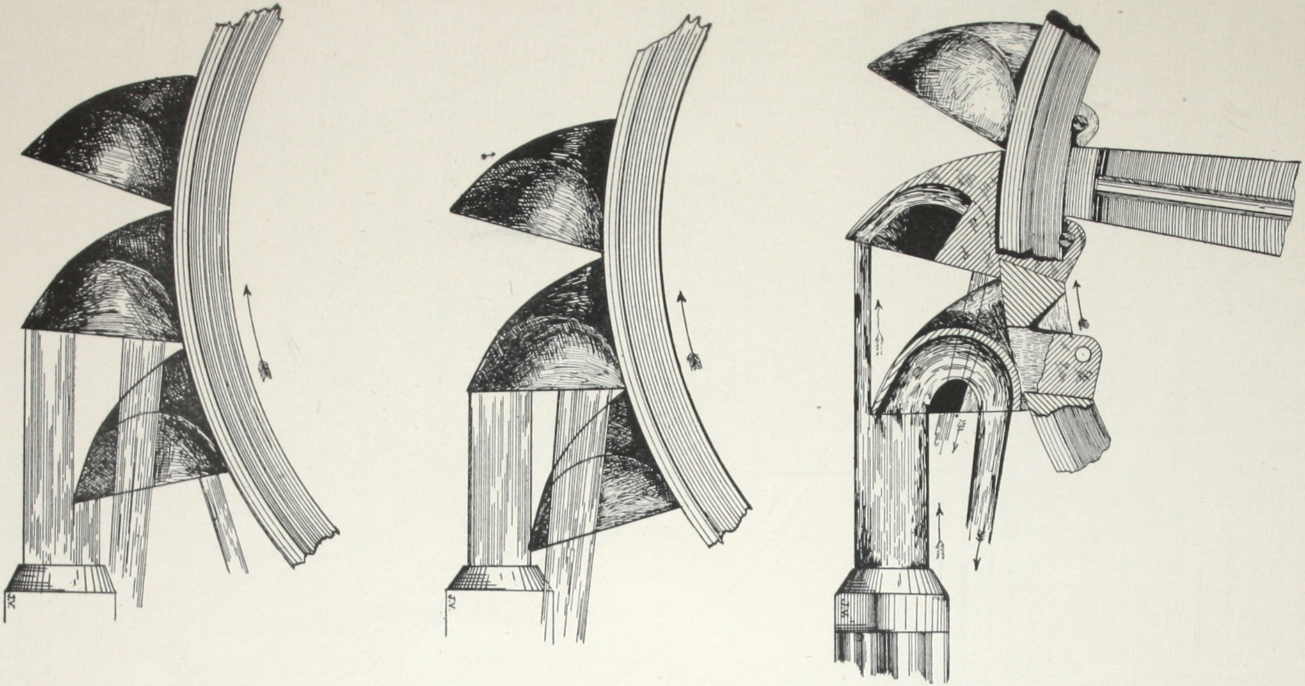
3. The **Hug** Bucket does not throw its water sideways, against casing or foundations, either as stream or spray, but discharges it straight downwards into the dead water of the tail race. Therefore no eating away of foundation.

THE BUCKET FASTENING

In wheels of 12 inches in diameter, and under, the buckets are cast on the rim of the wheel, but in larger sizes, they are made detachable, to allow replacement when worn by sand or damaged by stones issuing from the nozzle.

Our patented form of bucket fastening, as shown on next page, is superior to the usual bolt fastening in strength and security, and in ease of attaching and detaching buckets.

The bucket is provided with a tenon which fits a mortise in the rim of the wheel. A steel key driven through a hole in the tenon engages the web of the wheel rim, thus drawing the tenon to its proper seat in the mortise, and causing the rear support of the bucket to bear firmly against the face of the rim. The bucket is so adjusted to the wheel rim that the tenon will be firmly seated in the mortise as soon as the rear support bears against the rim. This support relieves the tenon of all bending stress due to the force of the stream.



Stream and Bucket, showing action of Water when Wheel is not in motion. Also Fastening of the Bucket.

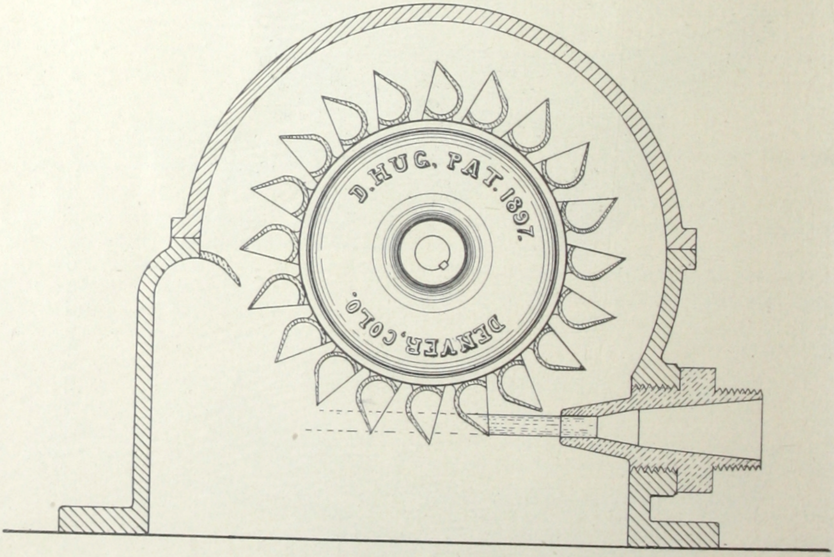
This method of fastening buckets has been employed on **Hug** Wheels that have been in constant use during the past five years, and has not given trouble in any case.

The renewal of **Hug** Buckets entails small expense, and requires less time and skill than for any other style of fastening. All buckets and keys are properly fitted before leaving the shop, so that they can be attached to the wheel with perfect assurance that over-straining of tenon or key is impossible.

THE PROTECTOR

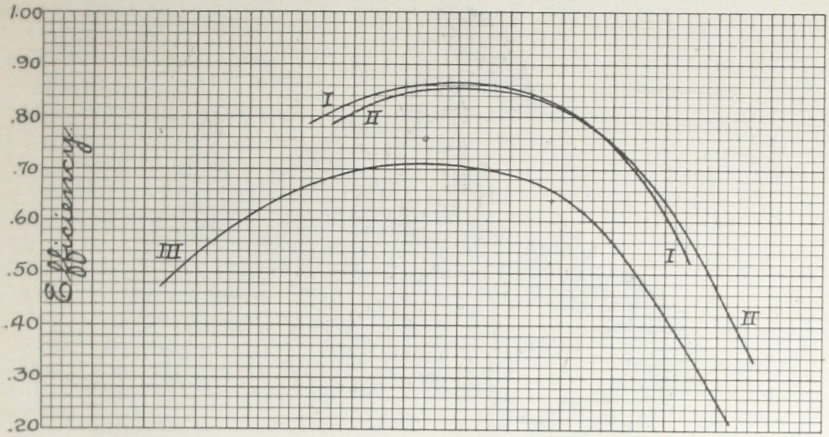
In all cases there are wetted surfaces in the buckets, and the water thrown from these surfaces by centrifugal force will be carried around by the wheel when in a closed case, unless caught and deflected by some means.

The **Hug** "Protector" is a guard or frame, which, in connection with the extended end of the case opposite the nozzle, prevents water from being carried around by the wheel. It is properly a continuation of the iron housing as shown in sectional cut of 6-inch motor.



Sectional View of Small Motor

TEST OF A 12 INCH HUG WATER MOTOR



PRINTERS' ERRATA.

On page 9, under Test Curves, Curve III Test, instead of ¾-inch nozzle, should read ¼-inch nozzle.

Iteica should read Ithaca.

On page 6, first line, under "The Bucket," should read, On page 8 an assembled view.

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on the second Hug Motor, together with diagrams showing the efficiencies when working under two heads, the one corresponding to about 25 pounds pressure, the other to about 80 pounds pressure.

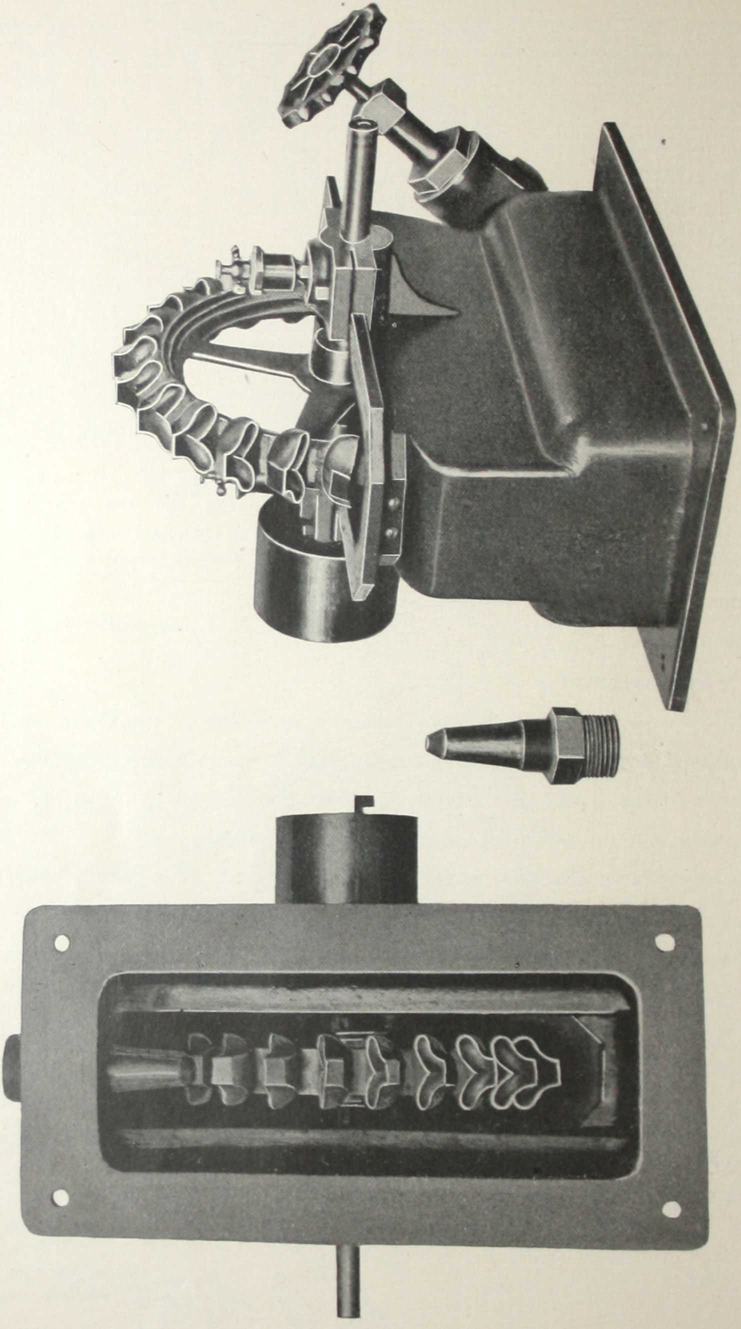
The results of the test show very favorably for your motor. The efficiency obtained with a head of 182 feet corresponding to 86.5 per cent. You will note that the results are slightly higher with the frame in position than with it out, but the difference is not a great amount, running not far from 1/2 per cent under working conditions.

The last motor is a decided improvement over the one first tested and consideringits size, it has an exceedingly high efficiency.

You are certainly to be congratulated on the high efficiency which has been attained by this second motor.

Yours very truly,

R. C. Carpenter



12 Inch Hug Motor, Tested by Professor Carpenter at Cornell University.

In August, 1898, a 12-inch Hug motor (listed in this catalogue as 12-inch wheel was tested under 182.23 feet head by Professor R. C. Carpenter at Cornell University, Ithaca, N. Y. The principal results of this test are represented by the foregoing diagram.

The 12-inch HUG Water Motor tested by Prof. Carpenter is designed to receive water from nozzles ranging in size from ¼ inch to ½ inch in diameter. The efficiencies attained in this test with the different nozzles are as follows:

Diameter of Nozzle.	Efficiency (per cent.)
1-2 inch	86.5
7-16 inch	86.5
3-8 inch	85.5
1-4 inch	71.0

The efficiency of 86.5 per cent. for the 1-2 and 7-16 inch nozzles is the highest ever reached under similar conditions. The efficiencies of 85.5 per cent. and 71.0 per cent., obtained when using the 3-8 inch and the 1-4 inch nozzles, respectively, are exceptionally high, for these nozzles deliver to the wheel quantities of water equal to only 56.25 per cent. and 25.00 per cent. of the maximum capacity of the wheel. The attainment of such high efficiencies when using quantities of water so much smaller than the maximum capacity, is of the greatest importance, and is possible only with a **Hug** Wheel.

The average efficiency from one-half to maximum water supply (one-half load to full load), is 86.1 per cent., while the average efficiency from one-quarter to maximum water supply (one-fifth load to full load), is 82.6 per cent.

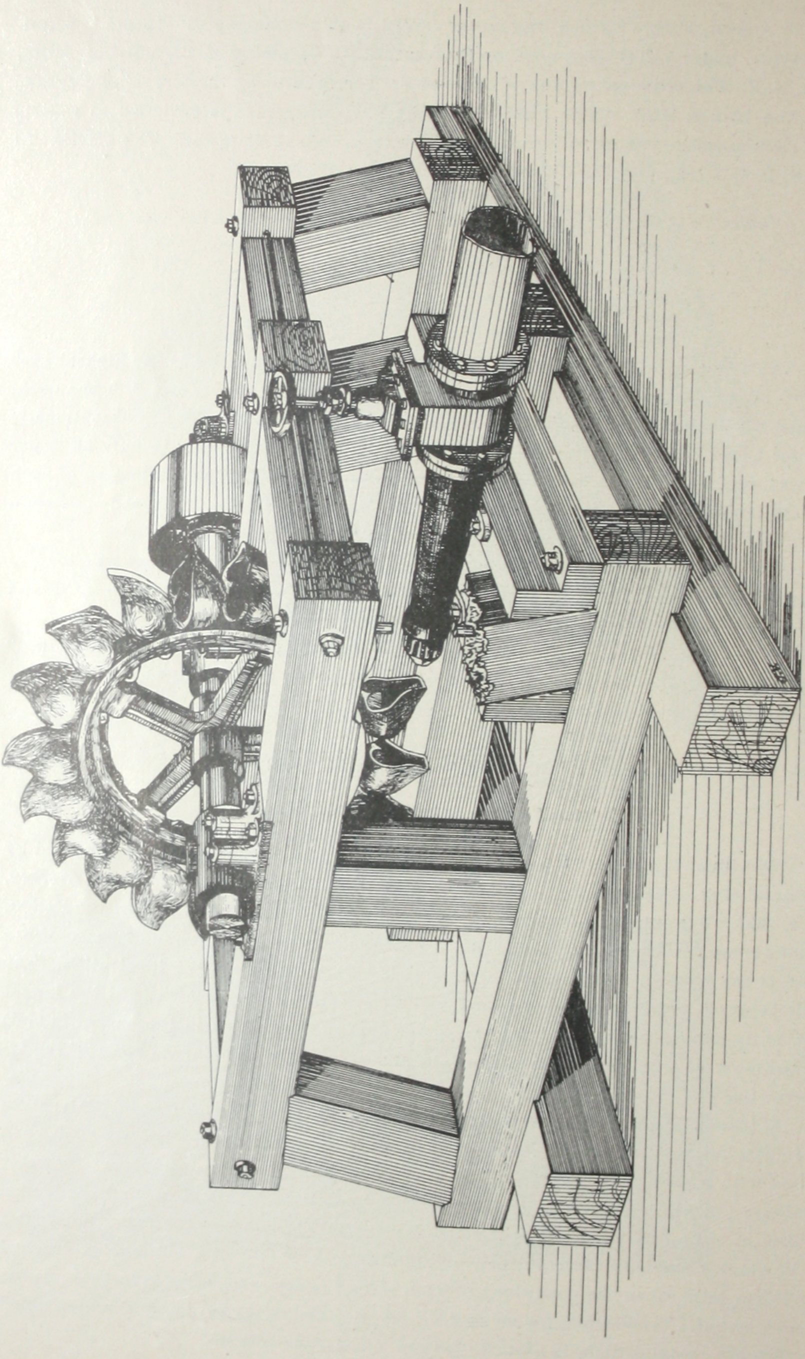
A very desirable feature is the range of speed that is possible, without materially decreasing the power; for example, at full load, a variation in speed of 10 per cent. from the normal, will decrease the power only 2 per cent.

(From "Engineering News," New York, Nov. 24, 1898).

Tests of a New Impulse Water Wheel

"We illustrate herewith a new form of impulse water wheel, recently invented by Mr. Daniel Hug, of Denver, Colo., and covered by U. S. Patents Nos. 576, 728 and 576, 849, Feb. 9, 1897. The principal feature of this wheel which distinguishes it from the Pelton, and other impulse wheels in which the buckets are carried on the circumference of the wheel, is the form of the buckets. The form is clearly shown in the illustration. The nozzle is so placed as to throw the jet horizontally into a bucket which is at the lowest point of its travel, and the jet on striking the V-shaped partition in the bucket is split into two halves, which are diverted upward and outward by the curved form of the interior of the bucket.

A 12-inch wheel was recently sent to Prof. R. C. Carpenter, of Cornell University, for a complete test with different sizes of nozzles and different heads. We have been favored with a copy of the report, which is one of the most elaborate reports of a water wheel test that we have ever seen. Tests were made both with and without the frame, showing in some cases a considerable increase in efficiency when the frame was used, but in other cases the increase was unimportant. * * * The efficiencies reached over 85 per cent. when the conditions of load, size of nozzle, etc., were favorable, appear to us to be quite remarkable for so small a wheel. The range of power through which the efficiency remains high, is also, we believe, exceptionally good."



36 inch Hug Wheel on Open Timber Frame

STANDARD WHEELS

The term "Standard Wheels" applies only to those wheels ranging from 6 inches to 6 feet in diameter, as mentioned in the Power Tables and Price List, on pages 17 to 25. These "Standard Wheels" are designed to have a large capacity for water, and to satisfy general power requirements. For special conditions we build special wheels.

The "head" or pressure of the water determines the velocity at which the buckets should travel, and the diameter of the wheel may be chosen to give the desired number of revolutions per minute. The size and number of the buckets depend on the quantity of water to be used, and also on the diameter of the wheel.

The superior form of our bucket renders it possible to construct **Hug Wheels** varying widely as to size and capacity, yet retaining the highest degree of efficiency.

MULTIPLE NOZZLES

When the speed of a "Standard Wheel" of a given capacity is too low, a smaller wheel suited to the desired speed may be used, its power being increased by causing two or more streams to act on it simultaneously, by means of a multiple nozzle, as shown on page 33.

The power developed by such a wheel may be regulated by opening or closing the valves attached to the different nozzles. In cases where the changes of load during the day are frequent, but such as do not require automatic regulation, this means of control is of special advantage, and need involve no loss of efficiency.

THE FRAME AND HOUSING

A heavy framework of timber, if well built, will answer for general purposes where the power developed is not great. We send with each wheel full working drawings, showing the proper construction of such framework; also a template for the correct setting of the nozzle.

When a large amount of power is to be developed, and for permanent plants in general, it is best to have the wheels mounted on an iron framework set in masonry, and enclosed in an iron housing. Wheels provided with cast iron cases are shipped ready to be bolted to the foundation, being fully adjusted before leaving our works.

Only the best workmen are employed in building **Hug Wheels**, so that the mechanical construction is of the highest order, and according to the best modern practice. Durability and efficiency are maintained indefinitely, except when gritty water is used, in which case a new set of buckets may be required from time to time.

THE PIPE LINE

The design of a pipe line is of greatest importance in the development of a water power, inasmuch as on it depends the effective "head" or pressure at which the water can be delivered to the wheel.

The friction of the water flowing through the pipe often causes a serious loss of pressure. This loss may be avoided to a considerable extent by choosing the diameter of the pipe in proper ratio to the length, and by having as few turns as possible. Unavoidable bends should be of long radius, and if anything, of larger diameter than the straight pipe.

MOTORS

Hug Water Wheels 24 inches in diameter and under, enclosed in cast iron cases and ready to be connected to the supply pipe, are termed "Motors." In the design and construction of these "Motors," we use as much care to secure the highest efficiency as in the case of the larger wheels, and only the best material and workmanship are employed.

The wheel and buckets of the 6-inch and the 12-inch "Motors" are cast in one piece. The buckets are formed entirely in dry sand cores, thus making them remarkably smooth and perfect.

The casing is of cast iron, neat in appearance, and properly designed as to strength and space for discharged water.

All bearings are lined with the best grade of Babbitt Metal, and are made self-aligning and ring-oiling, so as to require the least possible care or attention.

The nozzle is furnished with three interchangeable tips of different diameters, to provide for a change in either the pressure of the water, or the load under which the wheel is to run. The smallest stream that will do the work should always be used. If more power is required, a larger tip may be substituted. In the 6-inch, 12-inch and 15-inch "Motors," the tips may be changed by unscrewing the nozzle from the outside of the case. In the larger sizes, a suitable hand hole is provided in the side of the case, through which the nozzle tip can be reached.

The Hug Water Motor is adapted to all purposes for which power is required, it maintains its high efficiency under a wide range of pressures. In cities or towns, even under excessive high water rates, it holds its own as compared to any other service of power in small units. In the country and mountainous districts where high heads are available, a small wheel will furnish a large amount of power.

INSTALLING A MOTOR

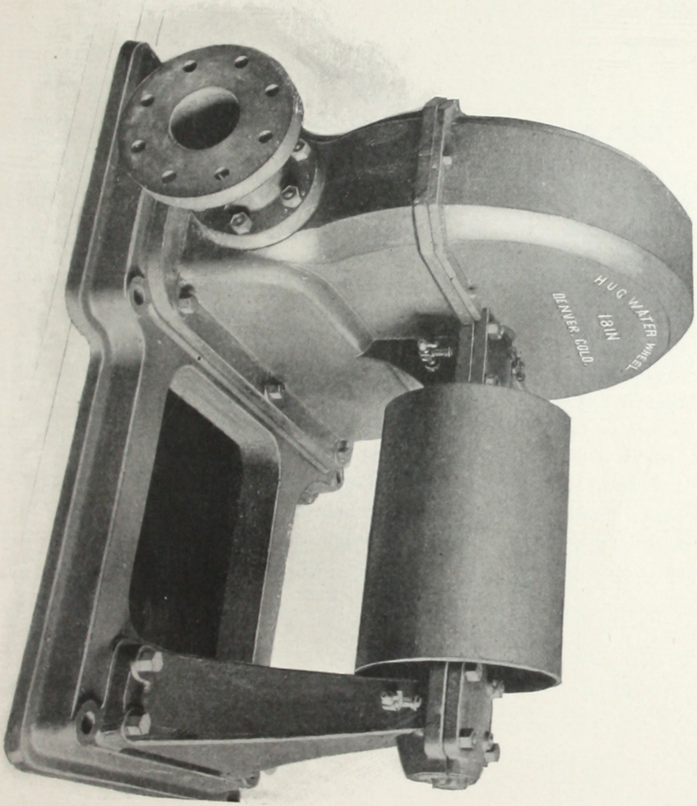
To secure the best results, note carefully the following instructions:

1. The supply pipe must be of proper size to deliver the required amount of water without excessive loss of pressure. If a single tap in the main is not large enough, use two or more taps as necessary, and unite in one pipe a short distance from the main. The conditions as to length of pipe and pressure vary greatly, and we will gladly advise our patrons in this matter on receipt of the necessary data.

2. The discharge pipe must be ample to dispose of the waste water.

3. The speed at which the wheel is to run should be that, due to the pressure at the nozzle, as given in the "Power Table," pages 17-23. This pressure may be ascertained by placing a gauge near the nozzle, and noting the pressure when the valve is open and the water running freely.

Bases for motors in wood or iron, with which to connect discharge pipe, will be charged extra.



18 Inch Wheel

EXPLANATION OF HUG WATER WHEEL TABLE

The power as calculated in the following pages are calculated for the Hug Water Wheel and based on a less efficiency than the tests warrant. Tests having been made under low head and small stream, as proven by pages 9 and 11.

Speed of wheel as given need not be kept very exact, because (as test curves show) the Hug Wheel allows a comparatively wider range of speed variations, without any appreciable falling off in power, than any other wheel known.

Though on the above account the Hug Water Wheel can dispense with a governor, when on any other style of wheel the governor is indispensable.

Governors for the most delicate regulations are furnished when so desired, and not the slightest fault has yet been found in that respect.

It is needless to say that the Hug Water Wheel is applicable to a higher advantage in all cases where any impulse wheel can be used, for the efficiency is such that in most cases the saving, as compared to any other wheel, will more than pay the whole cost in less than twelve months.

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle Hug Water Wheels and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

Head in Feet	SIZE OF WHEELS.	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
20 8.670 lbs. 2151.974	Theoretical H. P	.05	.11	.29	.44	.79	1.77	3.15	4.93	7.10
	Horse Power....	.04	.09	.25	.38	.68	1.52	2 71	4.24	6.10
	Cubic Feet......	1.30	2.93	7.75	11.73	20.84	46.94	83.36	130 41	187.76
	Miner's Inches..	.87	1.95	5.17	7.82	13.89	31.29	55.57	86.94	125.17
	Revolutions.....	685	342	274	228	171	114	85	69	57
30 13.005 lbs. 2635.628	Theoretical H.P..	.09	.20	.54	.81	1.44	3.26	5.79	9.06	13.04
	Horse Power....	.07	.17	.49	.70	1.24	2.80	4.98	7.79	11.20
	Cubic Feet......	1.59	3.59	9.49	14.37	25.55	57.50	102.20	159.72	230.00
	Miner's Inches..	1.06	2.39	6.32	9.58	17.03	38.33	68.13	106.48	153.33
	Revolutions.....	840	420	336	280	210	140	105	84	70
40 17.340 lbs. 3043 397	Theoretical H.P..	.14	.31	.83	1.25	2.23	5.02	8.92	13.95	20.08
	Horse Power....	.12	.26	.71	1.07	1.92	4.31	7.67	12.00	17.26
	Cubic Feet......	1.84	4.15	10.96	16.60	29.50	66.39	118.03	184.43	265.56
	Miner's Inches..	1.23	2.77	7.30	11.07	19.67	44.26	78.69	122.95	177.04
	Revolutions......	968	484	387	323	242	161	121	97	80
50 21.675 lbs. 3402.613	Theoretical H.P..	.19	.44	1.17	1.75	3.12	7.02	12.48	19.50	28.08
	Horse Power....	.16	.37	1.00	1.50	2.68	6.03	10.72	16.77	24.14
	Cubic Feet......	2.06	4.64	12.25	18.56	32.99	74.24	131.96	206.20	296.96
	Miner's Inches..	1.37	3.09	8.16	12.37	21.99	49.49	87.97	137.46	197.97
	Revolutions.	1082	540	433	361	270	180	135	108	90
60 26.010 lbs. 3727.375	Theoretical H. P.	.25	.57	1.52	2.30	4.10	9.22	16.40	25.63	36.90
	Horse Power....	.21	.49	1.31	1.98	3.52	7.93	14.10	22.04	31.73
	Cubic Feet......	2.26	5.08	13.42	20.33	36.14	81.32	144.56	225.88	325.28
	Miner's Inches..	1.51	3.39	8.95	13.55	24.09	54.21	96.37	150.58	216.85
	Revolutions.	1186	592	474	395	296	197	148	118	98
70 30.345 lbs. 4026.007	Theoretical H. P.	.32	.72	1.92	2.91	5.16	11.64	20.64	32.30	46.56
	Horse Power....	.27	.62	1.65	2.50	4.44	10.00	17.75	27.78	40.00
	Cubic Feet......	2.44	5.49	14.50	21.95	39.00	87.80	156.00	243.98	351.20
	Miner's Inches..	1.62	3.66	9.66	14.63	26.00	58.53	104.00	162.65	234.13
	Revolutions	1280	640	512	427	320	213	160	128	106
80 34.680 lbs. 4303.997	Theoretical H.P.	.39	.89	2.35	3.55	6.32	14.22	25.28	39.45	56.88
	Horse Power....	.33	.76	2.02	3.05	5.43	12.23	21.74	33.93	48.92
	Cubic Feet......	2.60	5.87	15.50	23.47	41.70	93.88	166.80	260.83	375.52
	Miner's Inches ..	1.73	3.91	10.34	15.64	27.80	62.58	111.20	173.88	250.34
	Revolutions	1370	684	546	456	342	228	171	137	114
90 39.015 lbs. 4565.048	Theoretical H. P.	.47	1.06	2.77	4.24	7.52	16.96	30.08	47.08	67.84
	Horse Power....	.40	.91	2.37	3.64	6.46	14.58	25.87	40.49	58.34
	Cubic Feet......	2.76	6.22	16.26	24.89	44.24	99.56	176.96	276.65	398.24
	Miner's Inches..	1.84	4.14	10.84	16.59	29.49	66.37	117.97	184.43	265.49
	Revolutions.....	1453	726	581	484	363	242	181	145	121
100 43.350 lbs. 4812.000	Theoretical H. P.	.55	1.24	3.28	4.96	8.84	19.84	35.36	55.14	79.36
	Horse Power....	.47	1.06	2.82	4.26	7.60	17.06	30.41	47.42	68.25
	Cubic Feet......	2.91	6.56	17.33	26.24	46.64	104.96	186.56	291.61	419.84
	Miner's Inches..	1.94	4.37	11.56	17.49	31.09	69.97	124.37	194.40	279.89
	Revolutions.....	1528	764	613	509	382	254	191	153	127

FORMULA USED IN THIS TABLE.

Spouting velocity in feet per minute: $V=\sqrt{2gH}\times60=\sqrt{64.32H}\times60=\sqrt{H}\times8.01996\times60=\sqrt{Head}\times8.02\times60$.

Pressure in lbs. per square inch: $P=.433507$ times head in feet. Miner's Inches $=\frac{2}{3}\times Q$.

Discharge in Cubic Feet per minute: $Q=V\times$Area of nozzle in Square Feet. No allowance has been made for friction in nozzle.

Weight of one Cubic Foot of water at maximum density at 39.2° Fahrenheit=62 425 lbs.

Theoretical Horse Power per minute$=\frac{Q\times62.425\times H}{33000}$.

Horse Power (under theoretical horse power)=86 per cent of theoretical horse power.

Revolutions per minute$=\frac{V}{2\pi D}=\frac{V}{6.2832D}$.

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle Hug Water Wheels and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

Head in Feet.	SIZE OF WHEELS	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
110	Theoretical H, P.	.63	1.43	3.78	5.72	10.20	22.88	40.80	63.62	91.52
	Horse Power....	.54	1.23	3.25	4.92	8.77	19.68	35.08	54.71	78.72
47.685 lbs.	Cubic Feet.....	3.05	6.88	18.17	27.52	48.92	110.08	195.68	305.85	440.32
	Miner's Inches..	2.03	4.58	12.12	18.34	32.61	73.38	130.45	203.90	293.54
5046.873	Revolutions......	1606	803	643	535	401	267	200	160	134
120	Theoretical H. P.	.72	1.63	4.31	6.53	11.60	26.12	46.40	72.52	104.48
	Horse Power....	.62	1.40	3.71	5.61	9.97	22.46	39.90	62.37	89.85
52.020 lbs.	Cubic Feet......	3.19	7.19	18.98	28.75	51.08	115.00	204.32	319.45	460.00
	Miner's Inches..	2.12	4.79	12.66	19.16	34.05	76.66	136.21	212.96	306.66
5271.305	Revolutions	1678	838	671	559	419	279	209	167	139
130	Theoretical H. P.	.82	1.84	4.86	7.38	13.08	29.52	52.32	81.76	118.08
	Horse Power....	.70	1.58	4.18	6.35	11.24	25.39	44.99	70.31	101.55
56.355 lbs.	Cubic Feet......	3.32	7.48	19.75	29.92	53.20	119.68	212.80	332.49	478.72
	Miner's Inches..	2.21	4.98	13.18	19.94	35.46	79.78	141.86	221.66	319.14
5486.546	Revolutions	1746	872	698	582	436	290	218	174	145
140	Theoretical H. P.	.91	2.05	5.43	8.22	14.62	32.88	58.48	91.38	131.52
	Horse Power....	.78	1.76	4.67	7.07	12.57	28.28	50.28	78.58	113.12
60.690 lbs.	Cubic Feet......	3.45	7.76	20.50	31.05	55.20	124.20	220.80	345.04	496.80
	Miner's Inches..	2.30	5.17	13.66	20.70	36.80	82.80	147.20	230.03	331.20
5693.654	Revolutions	1812	906	725	604	453	302	226	181	151
150	Theoretical H. P.	1.01	2.28	6.02	9.12	16.21	36.48	64.84	101.34	145.92
	Horse Power....	.87	1.96	5.18	7.84	13.94	31.37	55.76	87.15	125·50
65.026 lbs.	Cubic Feet......	3.57	8.03	21.22	32.14	57.14	128.56	228.56	357.15	514.24
	Miner's Inches..	2.38	5.35	14.14	21.42	38.09	85.71	152.36	238.10	342.84
5893.448	Revolutions.	1876	938	751	625	469	312	234	187	156
160	Theoretical H. P.	1.11	2.51	6.63	10.04	17.84	40.16	71.40	111.64	160.76
	Horse Power....	.96	2.16	5.70	8.64	15.36	34.56	61.44	96.01	138.26
69.361 lbs.	Cubic Feet......	3.68	8.30	21.92	33.20	59.00	132.80	236.00	368.86	531.20
	Miner's Inches..	2.46	5.53	14 62	22.13	39.34	88.52	157.38	245.91	354.11
6086.746	Revolutions	1937	968	775	646	484	323	242	193	161
170	Theoretical H. P.	1.22	2.75	7.57	11.00	19.56	44.01	78.25	122.27	176.07
	Horse Power....	1.05	2.36	6.51	9.46	16.82	37.85	67.29	105.15	151.42
73.696 lbs.	Cubic Feet......	3.80	8.55	22.59	34.22	60.80	136.88	243.20	380.22	547.52
	Miner's Inches..	2.53	5.70	15.06	22.81	40.55	91.25	162.20	253.48	365.00
6274.078	Revolutions	1997	998	798	665	499	333	249	199	166
180	Theoretical H. P.	1.33	2.99	7.97	11.98	21.31	47.95	85.26	133.21	191.83
	Horse Power....	1.14	2.58	6.85	10.31	18.33	41.24	73.32	114.56	165.00
78.031 lbs.	Cubic Feet......	3.91	8.80	23.42	35.21	62.60	140.84	250.40	391.24	563.36
	Miner's Inches..	2.60	5.87	15.62	23.47	41.73	93.89	166.92	260.82	375.56
6455.971	Revolutions	2054	1027	822	684	513	342	256	205	171
190	Theoretical H. P	1.44	3.25	8.58	13.00	23.11	52.01	92.46	144.47	208.04
	Horse Power....	1.24	2.79	7.38	11.18	19.88	44.72	79.52	124.24	178.91
82.366 lbs.	Cubic Feet......	4.02	9.04	23.88	36.18	64.28	144.72	257.12	401.96	578.88
	Miner's Inches..	2.67	6.03	15.92	24.11	42.87	96.46	171.48	267.97	385.84
6632.860	Revolutions	2110	1055	844	703	527	351	263	211	176
200	Theoretical H. P.	1.56	3.51	9.27	14.04	24.96	56.16	99.84	156.02	224.67
	Horse Power....	1.34	3.02	7.95	12.07	21.46	48.30	85.87	134.17	193.20
86.701 lbs.	Cubic Feet......	4.12	9.28	24.50	37.12	66.00	148.48	264.00	412.40	593.92
	Miner's Inches..	2.74	6.18	16.26	24.74	43.96	98.97	175.84	274.93	395.88
6805.178	Revolutions	2166	1083	866	722	541	361	270	216	180
210	Theoretical H. P	1.67	3.77	9.95	15.10	26.86	60.43	107.44	167.87	241.74
	Horse Power....	1.44	3.25	8.56	13.00	23.08	52.00	92.32	144.37	208.00
91.036 lbs.	Cubic Feet......	4.22	9.51	25.10	38.03	67.60	152.12	270.40	422.59	608.48
	Miner's Inches..	2.81	6.34	16.68	25.36	45.07	101.44	180.28	281.73	405.76
6973.261	Revolutions	2218	1109	887	739	554	369	277	222	185
220	Theoretical H. P.	1.80	4.05	10.69	16.20	28.80	64.80	115.20	180.00	259.20
	Horse Power....	1.54	3.48	9.19	13.93	24.77	55.72	99.08	154.80	222.90
95.371 lbs.	Cubic Feet......	4.32	9.73	25.69	38.92	69.20	155.68	276.80	432.53	622.72
	Miner's Inches..	2.88	6.48	17.12	25.95	46.13	103.80	184.54	288.35	415.20
7137.350	Revolutions	2272	1136	909	757	568	378	284	227	189

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle HUG WATER WHEELS and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

HEAD IN FEET	SIZE OF WHEELS.	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
230 99.706 lbs. 7297.782	Theoretical H. P	1.92	4.33	11.43	17.31	30.78	69.27	123.12	192.42	277.08
	Horse Power....	1.65	3.72	9.83	14.89	26.48	59.57	105.92	165.48	238.28
	Cubic Feet......	4.42	9.95	26.27	39.80	70.76	159.20	283.04	442.26	636.86
	Miner's Inches..	2.94	6.63	17.52	26.54	47.16	106.16	188.64	294 84	424.64
	Revolutions.....	2322	1161	929	774	580	387	290	232	193
240 104.041 lbs. 7454.702	Theoretical H.P..	2.05	4.61	12.15	18.46	32.80	73.83	131.20	205.10	295.32
	Horse Power....	1.76	3.97	10.45	15.87	28.22	63.50	112.88	176.38	254.00
	Cubic Feet......	4.51	10.16	26.84	40.65	72.28	162.60	289.12	451.76	650.40
	Miner's Inches..	3.01	6.77	17.90	27 10	48.18	108.42	192.72	301.18	433.68
	Revolutions	2372	1186	949	790	593	395	296	237	197
250 108.376 lbs. 7608.445	Theoretical H.P..	2.18	4.90	12.95	19.62	34.88	78.50	139.52	218.05	314.00
	Horse Power....	1.87	4.22	11.14	16.87	30.00	67.51	120.00	187.52	270.04
	Cubic Feet......	4.61	10.37	27.39	41.49	73.76	165.96	295.04	461.08	663.84
	Miner's Inches..	3.07	6.91	18.26	27.66	49.18	110.66	196.72	307.39	442.64
	Revolutions......	2420	1210	968	806	605	403	302	242	201
260 112.711 lbs. 7759.109	Theoretical H.P..	2.31	5.20	13.74	20.81	37.00	83.25	148.00	231.26	333.00
	Horse Power....	1.98	4.47	11.82	17.90	31.82	71.60	127.28	198.89	286.40
	Cubic Feet......	4.70	10.58	27.93	42.32	75.23	169.28	300.92	470.21	677.12
	Miner's Inches..	3.13	7.05	18.62	28.21	50.15	112.84	200.62	313.47	451.37
	Revolutions.	2470	1235	988	823	617	411	309	247	206
270 117.046 lbs. 7906.934	Theoretical H. P.	2.44	5.50	15.05	22.02	39.15	88.10	156.63	244.74	352.42
	Horse Power....	2.10	4.73	12.94	18.94	33.67	75.77	134.70	210.47	303.08
	Cubic Feet......	4.79	10.78	28.46	43.12	76.66	172.50	306.67	479.17	690.00
	Miner's Inches..	3.19	7.19	18.98	28.75	51.11	115.00	204.44	319.45	460.00
	Revolutions.	2516	1258	1006	838	629	419	314	251	209
280 121.381 lbs. 8052.015	Theoretical H. P.	2.58	5.81	15.36	23.26	41.35	93.04	165.40	258.46	372.16
	Horse Power....	2.22	5.00	13.21	20.00	35.56	80.00	142.25	222.27	320.00
	Cubic Feet......	4.88	10.98	28.99	43.91	78.07	175.66	312.28	487.96	702.67
	Miner's Inches..	3.25	7.32	19 33	29.27	52.05	117.11	208.19	325.31	468.44
	Revolutions	2562	1281	1025	854	640	427	320	256	213
290 125.717 lbs. 8194.547	Theoretical H.P.	2.72	6.13	16.19	24.51	43.58	98.07	174.35	272.43	392.29
	Horse Power....	2.34	5.27	13.92	21.08	37.48	84.34	149.94	234.28	337.37
	Cubic Feet......	4.96	11.17	29.50	44.69	79.45	178.77	317.82	496.60	715.10
	Miner's Inches ..	3.31	7.45	19.66	29.79	52.97	119.18	211.88	331.07	476.74
	Revolutions	2608	1304	1043	869	652	435	326	261	217
300 130.052 lbs. 8334.624	Theoretical H. P.	2.86	6.45	17.03	25.79	45.86	103.18	183.44	286.64	412.75
	Horse Power....	2.46	5.54	14.65	22.18	39.44	88.74	157.76	246.51	354.96
	Cubic Feet......	5.05	11.36	30.00	45.45	80.81	181.83	323.25	505.09	727.32
	Miner's Inches..	3.36	7.57	20.00	30.30	53.87	121.22	215.50	336.72	484.88
	Revolutions.....	2652	1326	1061	884	663	442	331	265	221
310 134.387 lbs. 8472.392	Theoretical H. P.	3.01	6.77	17.86	27.09	48.17	108.39	192.70	301.10	433.58
	Horse Power....	2.59	5.82	15.36	23.30	41.43	93.22	165.72	258.94	372.88
	Cubic Feet......	5.13	11.55	30.50	46.21	82.15	184.84	328.60	513.44	739.36
	Miner's Inches..	3.42	7.70	20.34	30.80	54.76	123.22	219.06	342.29	492.90
	Revolutions	2696	1348	1078	899	674	449	337	269	225
320 138.722 lbs, 8607.946	Theoretical H. P	3.15	7.10	18.75	28.42	50.52	113.67	202.09	315.77	454.71
	Horse Power....	2.71	6.11	16.13	24.44	43.45	97.76	173.80	271.56	391.05
	Cubic Feet......	5.21	11.73	30.99	46.95	83.46	187.80	333.85	521.65	751.20
	Miner's Inches..	3.47	7.82	20.66	31.29	55.64	125.19	222.56	347.77	500.78
	Revolutions......	2740	1370	1096	913	685	456	342	274	228
330 143.057 lbs. 8741.431	Theoretical H. P	3.30	7.44	19.65	29.76	52.91	119.05	211.64	330.69	476.20
	Horse Power....	2.84	6.39	16.90	25.59	45.50	102.38	182.00	284.39	409.52
	Cubic Feet......	5.29	11.92	31.47	47.67	84.75	190.70	339.02	529.74	762.83
	Miner's Inches..	3.53	7.94	20.98	31.78	56.50	127.14	226.02	353.16	508.55
	Revolutions......	2782	1391	1113	927	695	464	348	278	232
340 147.392 lbs. 8872.894	Theoretical H. P	3.45	7.78	20.54	31.12	55.33	124.50	221.33	345.84	498.00
	Horse Power....	2.97	6.69	17.66	26.76	47.58	107.07	190.35	297.42	428.28
	Cubic Feet......	5.37	12.09	31.94	48.39	86.03	193.57	344.13	537.71	774.30
	Miner's Inches..	3.58	8.06	21.30	32.26	57.35	129.05	229.42	358.47	516.20
	Revolutions......	2824	1412	1129	941	706	471	353	282	235

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle Hug Water Wheels and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

HEAD IN FEET.	SIZE OF WHEELS	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
350	Theoretical H. P.	3.61	8.12	21.47	32.50	57.79	130.03	231.17	361.21	520.14
	Horse Power....	3.10	6.99	18.46	27.95	49.70	111.83	198.80	310.64	447.32
151.727 lbs.	Cubic Feet.....	5.45	12.27	32.41	49.10	87.29	196.40	349.16	545.56	785.60
	Miner's Inches..	3.63	8.18	21.60	32.73	58.19	130.93	232.77	363.71	523.74
9002.433	Revolutions......	2865	1432	1146	955	716	477	358	286	238
360	Theoretical H. P.	3.76	8.48	22.38	33.91	60.28	135.64	241.15	376.80	542.59
	Horse Power....	3.24	7.29	19.25	29.16	51.84	116.65	207.39	324.04	466.62
156.062 lbs.	Cubic Feet......	5.53	12.45	32.87	49.79	88.52	199.18	354.11	553.30	796.75
	Miner's Inches..	3.68	8.29	21.92	33.19	59.02	132.79	236.07	368.87	531.17
9130.144	Revolutions	2906	1453	1161	968	726	484	363	290	242
370	Theoretical H. P.	3.92	8.83	23.32	35.33	62.81	141.33	251.26	392.60	565.35
	Horse Power....	3.37	7.59	20.06	30.38	54.02	121.55	216.08	337.64	486.20
160.397 lbs.	Cubic Feet......	5.61	12.62	33.32	50.48	89.75	201.93	359.00	560.93	807.74
	Miner's Inches..	3.74	8.41	22.22	33.65	59.83	134.62	239.33	373.95	538.49
9256.074	Revolutions	2946	1473	1178	982	736	491	368	294	245
380	Theoretical H. P.	4.08	9.19	24.28	36.77	65.38	147.10	261.52	408.63	588.43
	Horse Power....	3.51	7.90	20.88	31.62	56.22	126.51	224.91	351.42	506.04
164.732 lbs.	Cubic Feet......	5.68	12.79	33.77	51.16	90.95	204.64	363.80	568.46	818·57
	Miner's Inches..	3.78	8.52	22.52	34.10	60.63	136.43	242.54	378.97	545.72
9380.320	Revolutions	2986	1493	1194	995	746	498	373	298	249
390	Theoretical H. P.	4.24	9.56	25.42	38.23	67.97	152.95	271.91	424.86	611.80
	Horse Power....	3.65	8.22	21.71	32.88	58.46	131.53	233.84	365.38	526.15
169.067 lbs.	Cubic Feet......	5.75	12.96	34.21	51.83	92.14	207.32	368.56	575.89	829.28
	Miner's Inches..	3.84	8.64	22.80	34.55	61.42	138.21	245.71	383.93	552.86
9502.930	Revolutions.	3024	1512	1210	1008	756	504	378	302	252
400	Theoretical H. P.	4.41	9.92	26.22	39.71	70.61	158.87	282.44	441.31	635.49
	Horse Power....	3.79	8.53	22.55	34.15	60.72	136.63	242.89	379.52	546.52
173.402 lbs.	Cubic Feet......	5.83	13.12	34.65	52.49	93.32	209.96	373.28	583.23	839.85
	Miner's Inches..	3.88	8.75	23.10	34.99	62.21	139.97	248.84	388.82	559.90
9624.000	Revolutions	3063	1532	1226	1021	766	510	383	306	255
410	Theoretical H. P.	4.57	10.30	27.21	41.21	73.27	164.86	293.09	457.96	659.47
	Horse Power....	3.93	8.86	23.40	35.44	63.01	141.78	252.06	393.85	567.14
177.737 lbs.	Cubic Feet......	5.90	13.28	35.08	53.14	94.47	212.57	377.90	590.48	850.29
	Miner's Inches..	3.93	8.85	23.41	35.42	62.98	141.71	251.93	393.65	566.85
9743.578	Revolutions	3101	1551	1240	1034	775	517	388	310	258
420	Theoretical H. P.	4.47	10.68	28 20	42.73	75.97	170.93	303.88	474.82	683.74
	Horse Power....	4.08	9.18	24.25	36.75	65.33	147.00	261.34	408.34	588.01
182.072 lbs.	Cubic Feet......	5.97	13.44	35.50	53.78	95.62	215.15	382.48	597.63	860.59
	Miner's Inches..	3.98	8.96	23.66	35.85	63.74	143.43	254.99	398.42	573.72
9861.664	Revolutions	3139	1569	1255	1046	784	523	392	314	261
430	Theoretical H. P.	4.91	11.06	29.22	44.26	78.70	177.07	314.80	491.87	708.30
	Horse Power....	4.23	9.51	25.13	38.07	67.68	152.28	270.72	423.01	609.14
186.408 lbs.	Cubic Feet......	6.04	13.60	35.92	54.42	96.75	217.69	387.00	604.70	870.77
	Miner's Inches..	4.03	9.07	23.94	36.28	64.50	145.12	258.00	403.13	580.51
9978.355	Revolutions	3176	1588	1270	1058	794	529	397	317	264
440	Theoretical H. P.	5.09	11.45	30.20	45.82	81.46	183.29	325.84	509.13	733.16
	Horse Power....	4.37	9.85	25.97	39.40	70.05	157.62	280.22	437.85	630.51
190.743 lbs.	Cubic Feet......	6.11	13.76	36.34	55.05	97.87	220.21	391.48	611.70	880.84
	Miner's Inches..	4.07	9.18	24.22	36.70	65.24	146.80	260.99	407.80	587.23
10093.747	Revolutions	3212	1606	1285	1070	803	535	401	321	267
450	Theoretical H. P.	5.26	11.84	31.28	47.39	84.25	189.57	337.01	526.59	758.29
	Horse Power....	4.52	10.18	26.90	40.75	72.45	163.03	289.83	452.87	652.13
195.078 lbs.	Cubic Feet......	6.18	13.91	36.75	55.67	98.97	222.70	395.91	618.61	890.80
	Miner's Inches..	4.12	9.28	24.50	37.11	65.98	148.46	263.94	412.40	593.86
10207.791	Revolutions	3249	1624	1299	1083	812	541	406	325	270
460	Theoretical H. P.	5.44	12.24	32.33	48.98	87.07	195.92	348.31	544.24	783.71
	Horse Power....	4.68	10.53	27.80	42.12	74.88	168.49	299.55	468.04	673.99
199.413 lbs.	Cubic Feet......	6.25	14.07	37.15	56.38	100.07	225.15	400.28	625.44	900.63
	Miner's Inches..	4.17	9.38	24.76	37.52	66.71	150.10	266.85	416.96	600.43
10320.585	Revolutions	3285	1642	1314	1095	821	547	410	328	273

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle **Hug Water Wheels** and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

HEAD IN FEET.	SIZE OF WHEELS	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
	Theoretical H. P.	5.62	12.64	33.39	50.58	89.93	202.35	359.73	562.08	809.40
470	Horse Power....	4.83	10.87	28.71	43.50	77.34	174.02	309.37	483.39	696.08
	Cubic Feet.....	6.32	14.22	37.56	56.89	101.15	227.59	404.61	632.21	910.38
203.748 lbs.	Miner's Inches..	4.21	9.48	25.04	37.93	67.43	151.73	269.74	421.47	606.92
10432.175	Revolutions......	3320	1660	1328	1106	830	553	415	332	276
	Theoretical H. P.	5.80	13.05	34.46	52.21	92.81	208.84	371.27	580.12	835.37
480	Horse Power....	4.98	11.22	29.64	44.90	79.82	179.60	319.29	498.90	718.42
	Cubic Feet......	6.38	14.37	37.95	57.50	102.22	230.00	408.89	638.90	920.00
208.083 lbs.	Miner's Inches..	4.26	9.58	25.30	38.33	68.15	153.33	272.59	425.93	613.33
10542.562	Revolutions.....	3355	1678	1343	1118	839	559	419	335	279
	Theoretical H. P.	5.98	13.46	35.55	53.85	95.73	215.40	382.93	598.34	861.61
490	Horse Power....	5.14	11.57	30.57	46.31	82.33	185.24	329.32	514.57	740.98
	Cubic Feet......	6.45	14.52	38.35	58.09	103.28	232.38	413.13	645.52	929.54
212.418 lbs.	Miner's Inches..	4.30	9.68	25.56	38.73	68.85	154.92	275.41	430.34	619.69
10651.795	Revolutions.....	3390	1695	1356	1130	847	565	424	339	282
	Theoretical H. P.	6.16	13.87	36.64	55.50	98.68	222.03	394.72	616.75	888.12
500	Horse Power....	5.30	11.93	31.51	47.73	84.86	190.94	339.46	530.40	763.78
	Cubic Feet......	6.52	14.67	38.74	58.68	104.33	234.74	417.32	652.07	938.98
216.753 lbs.	Miner's Inches..	4.34	9.78	25.83	39.12	69.55	156.49	278.21	434.71	625.99
10759.968	Revolutions.....	3425	1712	1369	1141	856	570	428	342	285
	Theoretical H. P.	6.54	14.71	38.86	58.87	104.66	235.48	418.64	654.12	941.94
520	Horse Power....	5.62	12.65	33.42	50.62	90.00	202.51	360.03	562.54	810.07
	Cubic Feet......	6.65	14.96	39.51	59.84	106.39	239.39	425.59	664.98	957.58
225.423 lbs.	Miner's Inches..	4.43	9.97	26.34	39.89	70.93	159.59	283.72	443.32	638.38
10973.044	Revolutions.....	3492	1746	1397	1164	873	582	436	349	291
	Theoretical H. P.	6.92	15.57	41.13	62.30	110.75	249.20	443.02	692.22	996.80
540	Horse Power....	5.95	13.39	35.37	53.57	95.25	214.31	381.00	595.31	857.25
	Cubic Feet......	6.77	15.24	40.26	60.98	108.42	243.95	433.70	677.65	975.82
234.093 lbs.	Miner's Inches..	4.51	10.16	26.84	40.65	72.28	162.63	289.13	451.77	650.54
11182.077	Revolutions.....	3559	1780	1424	1186	890	593	445	356	296
	Theoretical H. P.	7.11	16.00	42.27	64.03	113.84	256.15	455.38	711.54	1024.62
550	Horse Power....	6.11	13.77	36.35	55.07	97.90	220.29	391.63	611.92	881.17
	Cubic Feet......	6.84	15.39	40.63	61.55	109.42	246.20	437.69	683.90	984.81
238.428 lbs.	Miner's Inches..	4.55	10.16	27.08	41.03	72.95	164.13	291.79	455.93	656.54
11285.150	Revolutions.....	3592	1796	1437	1197	898	598	449	359	299
	Theoretical H. P.	7.31	16.45	43.42	65.79	116.96	263.17	467.86	731.03	1052.69
560	Horse Power....	6.28	14.14	37.34	56.58	100.59	226.32	402.36	628.69	905.31
	Cubic Feet......	6.90	15.52	40.99	62.10	110.41	248.43	441.65	690.09	993.72
242.763 lbs.	Miner's Inches..	4.60	10.35	27.33	41.40	73.61	165.62	294.43	460.06	662.48
11387.261	Revolutions.....	3624	1812	1450	1208	906	604	453	362	302
	Theoretical H. P.	7.70	17.33	45.77	69.34	123.28	277.39	493.14	770.54	1109.58
580	Horse Power....	6.62	14.91	39.36	59.64	106.02	238.56	424.10	662.67	954.24
	Cubic Feet......	7.02	15.80	41.72	63.20	112.36	252.82	449.47	702.30	1011.31
251.434 lbs.	Miner's Inches..	4.68	10.53	27.82	42.13	74.91	168.55	299.64	468.20	674.21
11588.835	Revolutions.....	3688	1844	1476	1229	922	614	461	369	307
	Theoretical H. P.	8.10	18.24	48.06	72.96	129.71	291.86	518.87	810.74	1167.47
600	Horse Power....	6.97	15.68	41.33	62.75	111.55	251.00	446.23	697.24	1004.02
	Cubic Feet......	7.14	16.07	42.34	64.28	114.28	257.15	457.15	714.31	1028.60
260.104 lbs.	Miner's Inches..	4.76	10.71	28.23	42.85	76.19	171.43	304.77	476.20	685.74
11786.945	Revolutions.....	3752	1876	1501	1250	938	625	469	375	312
	Theoretical H. P.	8.51	19.16	50.58	76.64	136.25	306.58	545.03	851.61	1226.32
620	Horse Power....	7.32	16.47	43.50	65.91	117.18	263.66	468.72	732.39	1054.64
	Cubic Feet......	7.26	16.33	43.13	65.35	116.17	261.40	464.71	726.12	1045.61
268.774 lbs.	Miner's Inches..	4.84	10.89	28.67	43.56	77.45	174.26	309.81	484.08	697.07
11981.783	Revolutions.....	3814	1907	1526	1271	953	635	476	381	318
	Theoretical H. P.	8.93	20.09	53.04	80.38	142.90	321.53	571.61	893.15	1286.14
640	Horse Power....	7.68	17.28	45.61	69.13	122.89	276.52	491.59	768.11	1106.08
	Cubic Feet......	7.37	16.59	43.82	66.39	118.03	265.58	472.15	737.73	1062.34
277.444 lbs.	Miner's Inches..	4.91	11.07	29.22	44.26	78.69	177.05	314.76	491.82	708.22
217 .493	Revolutions.....	3874	1937	1549	1291	968	645	484	387	323

HUG WATER WHEEL TABLE

This table is calculated for standard single nozzle HUG WATER WHEELS and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for Horse Power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

HEAD IN FEET	SIZE OF WHEELS.	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
650	Theoretical H. P	9.14	20.56	54.00	82.27	146.26	329.10	585.06	914.17	1316.40
281.779 lbs.	Horse Power....	7.86	17.68	46.24	70.75	125.78	283.02	503.15	786.18	1132.10
	Cubic Feet......	7.43	16.72	44.17	66.91	118.95	267.65	475.82	743.48	1070.61
	Miner's Inches..	4.95	11.15	29.45	44.60	79.30	178.43	317.21	495.65	713.73
12268.242	Revolutions.....	3905	1952	1562	1301	976	650	488	390	325
660	Theoretical H.P..	9.35	21.04	55.56	84.18	149.65	336.72	598.62	935.34	1346.90
286.114 lbs.	Horse Power....	8.04	18.09	47.78	72.39	128.70	289.58	514.81	804.40	1158.33
	Cubic Feet......	7.49	16.85	44.50	67.42	119.86	269.70	479.47	749.17	1078.81
	Miner's Inches..	4.99	11.24	29.67	44.95	79.91	179.80	319.64	499.45	719.20
12362.268	Revolutions.....	3935	1968	1575	1311	984	656	492	393	328
680	Theoretical H.P..	9.78	22.00	58.10	88.03	156.50	352.14	626.03	978.18	1408.58
294.784 lbs.	Horse Power....	8.41	18.92	49.97	75.71	134.59	302.84	538.39	841.23	1211.38
	Cubic Feet......	7.60	17.11	45.17	68.44	121.67	273.75	486.68	760.44	1095.03
	Miner's Inches..	5.07	11.40	30.12	45.62	81.11	182.50	324.45	506.96	730.02
12548.156	Revolutions......	3994	1997	1594	1331	998	665	499	399	333
700	Theoretical H.P..	10.21	22.98	60.69	91.94	163.46	367.79	653.85	1021.65	1471.18
303.454 lbs.	Horse Power....	8.78	19.76	52.19	79.07	140.57	316.30	562.31	878.62	1265.21
	Cubic Feet......	7.71	17.36	45.83	69.43	123.44	277.75	493.78	771.54	1111.02
	Miner's Inches..	5.14	11.57	30.56	46.29	82.29	185.17	329.19	514.36	740.68
12731.349	Revolutions.....	4052	2026	1621	1350	1013	675	506	405	337
720	Theoretical H. P.	10.65	23.97	63.31	95.91	170.52	383.67	682.08	1065.75	1534.68
312.125 lbs.	Horse Power....	9.16	20.62	54.45	82.48	146.64	329.95	586.58	916.54	1319.82
	Cubic Feet......	7.82	17.60	46.48	70.42	125.19	281.69	500.79	782.48	1126.78
	Miner's Inches..	5.21	11.73	30.98	46.94	83.46	187.79	333.86	521.66	751.18
12911.943	Revolutions.....	4110	2055	1644	1370	1027	685	513	411	342
740	Theoretical H. P.	11.10	24.98	65.96	99.94	177.67	399.76	710.69	1110.46	1599.06
320.795 lbs.	Horse Power....	9.55	21.48	56.72	85.95	152.80	343.80	611.20	954.99	1375.20
	Cubic Feet......	7.93	17.85	47.12	71.39	126.92	285.58	507.69	793.28	1142.32
	Miner's Inches..	5.28	11.90	31.42	47.59	84.61	190.38	338.46	528.85	761.54
13090.035	Revolutions.....	4166	2083	1666	1388	1041	694	521	416	347
750	Theoretical H.P.	11.33	25.49	67.28	101.97	181.28	407.89	725.15	1133.04	1631.58
325.130 lbs.	Horse Power....	9.74	21.92	57.86	87.69	155.90	350.79	623.62	974.42	1403.16
	Cubic Feet......	7.98	17.97	47.44	71.87	127.77	287.50	511.11	798.62	1150.01
	Miner's Inches..	5.32	11.98	31.62	47.91	85.18	191.67	340.74	532.41	766.67
13178.191	Revolutions	4194	2097	1678	1398	1048	699	524	419	349
760	Theoretical H. P.	11.55	26.0	68.66	104.02	184.92	416.08	739.70	1155.78	1664.33
329.465 lbs.	Horse Power....	9.93	22.36	59.05	89.45	159.03	357.83	636.14	993.97	1431.32
	Cubic Feet......	8.04	18.09	47.76	72.35	128.62	289.41	514.51	803.93	1157.66
	Miner's Inches..	5.35	12.06	31.84	48.23	85.75	192.94	343.00	535.95	771.76
13265.769	Revolutions.....	4222	2111	1689	1407	1055	703	527	422	352
780	Theoretical H. P.	12.01	27.03	71.38	108.15	192.27	432.61	769.09	1201.70	1730.46
338.135 lbs.	Horse Power....	10.33	23.25	61.39	93.01	165.35	372.04	661.41	1033.46	1488.19
	Cubic Feet......	8.14	18.32	48.38	73.29	130.31	293.19	521.24	814.44	1172.79
	Miner's Inches..	5.43	12.21	32.26	48.86	86.87	195.46	347.49	542.96	781.86
13439.194	Revolutions.....	4278	2139	1711	1426	1069	713	535	428	356
800	Theoretical H. P	12.48	28.08	74.15	112.33	199.71	449.35	798.86	1248.22	1797.43
346.805 lbs.	Horse Power....	10.73	24.15	63.77	96.61	171.75	386.44	687.02	1073.47	1545.79
	Cubic Feet......	8.24	18.55	49.00	74.23	131.97	296.93	527.88	824.81	1187.73
	Miner's Inches..	5.49	12.37	32.67	49.48	87.98	197.95	351.92	549.87	791.82
13612.405	Revolutions......	4332	2166	1733	1444	1083	722	541	433	361
820	Theoretical H. P	12.95	29.14	76.95	116.57	207.25	466.31	829.00	1295.32	1865.26
355.475 lbs.	Horse Power....	11.55	25.06	66.18	100.25	178.23	401.03	712.94	1113.97	1604.12
	Cubic Feet......	8.35	18.78	49.61	75.15	133.60	300.62	534.43	835.06	1202.45
	Miner's Inches..	5.56	12.52	33.08	50.10	89.07	200.41	356.28	556.70	801.68
13779.450	Revolutions......	4386	2193	1754	1462	1096	731	548	438	365
840	Theoretical H. P	13.43	30.21	79.78	120.87	214.88	483.48	859.52	1343.00	1933.92
364.145 lbs.	Horse Power....	11.52	25.98	68.61	103.94	184.79	415.79	739.18	1154.98	1663.17
	Cubic Feet......	8.45	19.01	50.21	76.06	135.22	304.26	540.91	845.18	1217.06
	Miner's Inches..	5.63	12.68	33.48	50.71	90.15	202.84	360.61	563.45	811.37
13946.523	Revolutions......	4440	2220	1776	1480	1110	740	555	444	370

HUG WATER WHEEL TABLE.

This table is calculated for standard single nozzle HUG WATER WHEELS and is based upon the Heads or Pressures given in the first column as being *effective*.

Calculations for horse power are at 86 per cent efficiency; quantity of water required is given in cubic feet per minute and in miner's inches. One miner's inch equals 1½ cubic feet per minute.

The numbers in small figures under those that represent heads, represent pressure in pounds per square inch due to head in feet, and spouting velocity of water in feet per minute.

HEAD IN FEET.	SIZE OF WHEELS.	6 INCH	12 INCH	15 INCH	18 INCH	24 INCH	3 FOOT	4 FOOT	5 FOOT	6 FOOT
850	Theoretical H. P.	13.67	30.75	1.22	123.03	218.72	492.13	874.91	1367.05	1988.54
	Horse Power....	11.75	26.45	69.84	105.81	188.10	423.24	752.42	1175.66	1692.96
368.480 lbs.	Cubic Feet......	8.50	19.12	50.51	76.51	136.03	306.07	544.12	850.20	1224.28
	Miner's Inches ..	5.66	12.75	33.68	51.01	90.68	204.04	362.75	566.80	816.19
14029.289	Revolutions	4466	2233	1786	1488	1116	744	558	446	372
860	Theoretical H. P.	13.91	31.30	82.64	125.21	222.60	500.85	890.40	1391.25	2003.40
	Horse Power....	11.96	26.92	71.07	107.68	191.43	430.73	765.74	1196.47	1722.92
372.816 lbs.	Cubic Feet......	8.55	19.24	50.80	76.96	136.83	307.86	547.32	855.18	1231.47
	Miner's Inches..	5.70	12.83	33.87	51.31	91.22	205.24	364.88	570.12	820.98
14111.574	Revolutions	4492	2246	1797	1497	1123	748	561	449	374
880	Theoretical H. P.	14.40	32.40	85.55	129.60	230.40	518.42	921.63	1440.06	2073.68
	Horse Power....	12.38	27.86	73.57	111.46	198.15	445.84	792.60	1238.45	1783.36
381.486 lbs.	Cubic Feet......	8.65	19.46	51.39	77.85	138.41	311.42	553.64	865.07	1245.70
	Miner's Inches..	5.76	12.97	34.26	51.90	92.27	207.61	369.09	576.71	830.47
14274.701	Revolutions	4544	2272	1811	1514	1136	757	568	454	378
900	Theoretical H. P.	14.89	33.51	88.48	134.04	238.30	536.19	953.23	1489.43	2144.77
	Horse Power....	12.80	28.82	76.09	115.28	204.94	461.12	819.78	1280.91	1844.51
390.156 lbs.	Cubic Feet......	8.74	19.68	51.97	78.73	139.97	314.94	559.90	874.85	1259.78
	Miner's Inches..	5.83	13.12	34.65	52.49	93.31	209.96	373.26	583.23	839.85
14136.000	Revolutions	4595	2298	1838	1531	1149	766	574	459	383
920	Theoretical H. P.	15.39	34.63	91.44	138.54	246.29	554.16	985.18	1539.35	2216.67
	Horse Power....	13.23	29.78	78.64	119.14	211.81	476.58	847.26	1323.84	1906.33
398.826 lbs.	Cubic Feet......	8.84	19.90	52.54	79.60	141.52	318.42	566.08	884.51	1273.70
	Miner's Inches..	5.89	13.27	35.02	53.07	94.34	212.28	377.39	589.67	849.13
14595.517	Revolutions	4646	2323	1858	1548	1161	774	580	464	387
940	Theoretical H. P.	15.89	35.77	94.44	143.08	254.37	572.33	1017.48	1589.82	2289.34
	Horse Power....	13.67	30.76	81.22	123.05	218.75	492.20	875.03	1367.24	1968.83
407.496 lbs.	Cubic Feet......	8.94	20.11	53.11	80.46	143.05	321.86	572.20	894.07	1287.47
	Miner's Inches..	5.96	13.41	35.40	53.64	95.36	214.57	381.47	596.05	858.31
14753.3[illegible]3	Revolutions	4696	2348	1878	1565	1174	782	587	469	391
950	Theoretical H. P.	16.15	36.34	95.95	145.37	258.44	581.49	1033.76	1615.26	2325.97
	Horse Power....	13.89	31.25	82.52	125.02	222.26	500.08	889.04	1389.12	2000.33
411.831 lbs.	Cubic Feet	8.98	20.22	53.39	80.89	143.81	323.57	575.24	898.82	1294.30
	Miner's Inches..	5.99	13.48	35.59	53.92	95.87	215.71	383.49	599.21	862.87
14831.594	Revolutions	4721	2361	1889	1573	1180	787	590	472	393
960	Theoretical H. P.	16.40	36.91	97.31	147.67	262.53	590.69	1050.13	1640.83	2362.79
	Horse Power....	14.11	31.75	83.71	127.00	225.77	508.00	903.11	1411.11	2032.00
416.169 lbs.	Cubic Feet......	9.03	20.32	53.67	81.31	144.56	325.27	578.26	903.54	1301.10
	Miner's Inches..	6.02	13.55	35.78	54.21	96.37	216.85	385.51	602.36	867.39
14909.452	Revolutions	4746	2373	1898	1582	1186	791	593	474	395
980	Theoretical H. P.	16.92	38.07	100.53	152.31	270.78	609.25	1083.12	1692.37	2437.02
	Horse Power....	14.55	32.74	86.46	130.98	232.87	523.95	931.48	1455.44	2095.83
424.836 lbs.	Cubic Feet......	9.12	20.54	54.23	82.16	146.06	328.64	584.25	912.90	1314.58
	Miner's Inches..	6.08	13.69	36.16	54.77	97.37	219.09	389.50	608.60	876.38
15063 966	Revolutions	4795	2397	1918	1598	1198	799	599	479	399
1000	Theoretical H. P.	17.44	39.25	103.63	157.00	279.11	628.00	1116.44	1744.44	2512.00
	Horse Power....	15.00	33.75	89.11	135.01	240.03	540.07	960.14	1500.22	2160.31
433 507 lbs.	Cubic Feet......	9.22	20.74	54.23	82.99	147.54	331.98	590.19	922.17	1327.92
	Miner's Inches..	6.14	13.83	36.16	55.33	98.36	221.32	393.45	614.78	885.28
15216.891	Revolutions	4844	2422	1918	1614	1211	807	605	484	403

PRICE LIST

...OF...

STANDARD HUG WATER WHEELS AND MOTORS.

Motors are enclosed in cast iron cases.

The Single and Double Nozzle Wheels as Listed are for Mounting on Timber frame-work; these wheels are also furnished enclosed in Iron Cases,—Prices will be quoted on application.

For Special Wheels, of Special Diameter or Capacity, Prices will be quoted on application.

STANDARD MOTORS.

HEAD IN FEET.	6 INCH WHEEL.		12 INCH WHEEL		15 INCH WHEEL.		18 INCH WHEEL.		24 INCH WHEEL.	
	H. P.	PRICE	H. P.	PRICE	H. P.	PRICE.	H. P.	PRICE	H. P.	PRICE
20	.04	$ 35	.09	$ 60	0.25	$145	.38	$200	.68	$315
50	.16	35	.37	60	1.00	145	1.50	200	2.68	315
80	.33	35	.76	60	2.02	145	3.05	200	5.43	315
100	.47	35	1.06	60	2.82	145	4.26	200	7.60	315
150	.87	35	1.96	60	5.18	145	7.84	200	13.94	315
200	1.34	35	3.02	60	7.95	145	12.07	200	21.46	315
250	1.87	35	4.22	60	11.14	145	16·87	200	30.00	315
300	2.46	40	5.54	70	14.65	165	22.18	230	39.44	345
350	3.10	40	6.99	70	18.46	165	27.95	230	49.70	345
400	3.79	45	8.53	80	22.55	175	34.15	255	60.72	370
450	4.52	45	10.18	80	26.90	175	40.75	255	72.45	370
500	5.30	55	11.93	90	31.51	185	47.73	265	84.86	380
550	6.11	55	13.77	90	36.35	185	55.07	265	97.90	380
600	6.97	60	15.68	100	41.33	195	62.75	265	111.55	380
700	8.78	70	19.76	110	52.19	210	79.07	290	140.57	415
800	10.73	80	24.15	120	63.77	225	96.61	315	171.75	450
900	12.80	90	28.82	130	76.09	245	115.28	345	204.94	485
1000	15.00	105	33.75	140	89.11	260	135.01	375	240.03	530
LBS.	WEIGHT, 35-100		WEIGHT, 130-200		WEIGHT, 150-275		WEIGHT, 375-550		WEIGHT, 650-1100	

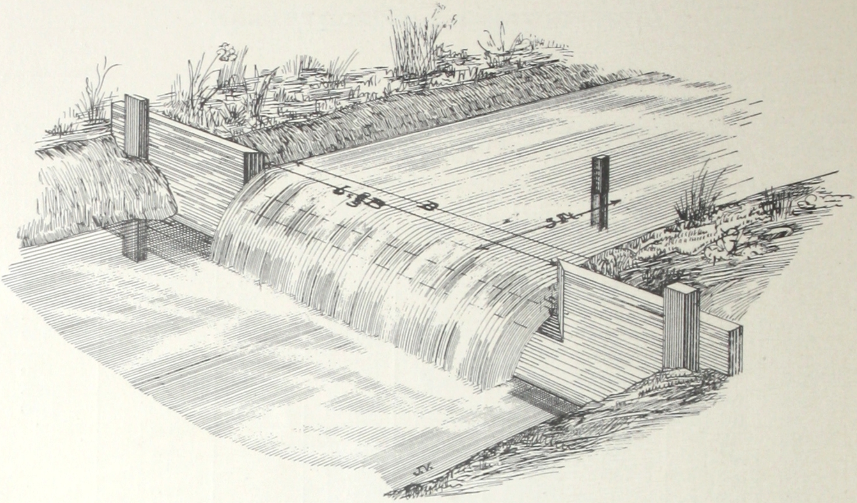
STANDARD SINGLE NOZZLE WHEELS.

HEAD IN FEET.	3 FOOT WHEEL.		4 FOOT WHEEL.		5 FOOT WHEEL.		6 FOOT WHEEL.	
	H. P.	Price	H. P.	Price	H. P.	Price	H. P.	Price
20	1.52	$255	2.71	$330	4.24	$400	6.10	$ 460
50	6.03	255	10.72	330	16.77	400	24.14	460
80	12.23	265	21.74	340	33.93	425	48.92	490
100	17.06	275	30.41	345	47.42	440	68.25	520
150	31.37	290	55.76	370	87.15	460	125.50	545
200	48.30	305	85.87	400	134.17	490	193.20	575
250	67.51	320	120.00	430	187.52	520	270.04	635
300	88.74	345	157.76	460	246.51	560	354.96	720
350	111.83	370	198.80	490	310.64	635	447.32	805
400	136.63	390	242.89	530	379.52	720	546.52	920
450	163.03	415	289.83	575	452.87	805	652.13	1035
500	190.94	450	339.46	620	530.40	890	763.78	1150
550	220.29	490	391.63	690	611.92		881.17	
600	251.00	520	446.23	775	697.24		1004.02	
700	316.30	575	562.31	860	878.62		1265.21	
800	386.44		687.02		1073.47		1545.79	
900	461.12		819.78		1280.91		1844.51	
1000	540.07		960.14		1500.22		2160.31	
Lbs.	Weight 900-1200		Weight, 1000-1900		Weight, 1600-2500		Weight, 2500-4500	

* * *

STANDARD DOUBLE NOZZLE WHEELS.

HEAD IN FEET.	3 FOOT WHEEL.		4 FOOT WHEEL.		5 FOOT WHEEL.		6 FOOT WHEEL.	
	H. P.	Price	H. P.	Price	H. P.	Price	H. P.	Price
20	3.04	$345	5.42	$430	8.48	$490	12.20	$ 575
30	5.60	345	9.96	430	15.58	490	22.40	575
40	8.62	355	15.34	435	24.00	500	34.52	585
50	12.06	375	21.44	440	33.54	505	48.28	600
60	15.86	390	28.20	450	44.08	520	63.46	610
70	20.00	415	35.50	460	55.56	530	80.00	635
80	24.46	435	43.48	485	67.86	545	97.84	660
100	34.12	460	60.82	520	94.84	575	136.50	690
150	62.74	500	111.52	575	174.30	660	251.00	805
200	96.60	550	171.74	660	268.34	750	386.40	920
250	135.02	600	240.00	750	375.04	860	540.08	1035
300	177.48	635	315.52	780	493.02	920	709.92	1100
350	223.66	660	397.60	815	621.28	990	894.64	1180
400	273.26	690	485.79	850	759.04	1065	1093.04	1295
450	326.06	720	579.66	890	905.74	1150	1304.26	1410
500	381.88	750	678.92	920	1060.80	1235	1527.56	1550
Lbs.	Weight. 1150-1450		Weight. 1350-2400		Weight. 2050-3200		Weight, 3500-6000	



MEASUREMENTS OF WATER BY MEANS OF A WEIR DAM

Across a slow moving portion of the stream construct a dam of one or more boards so that a comparatively quiet body of water will be formed. In this dam cut an opening as shown in the illustration, making the sides vertical and the bottom or crest of weir horizontal; bevel the side and bottom edges on the down-stream side at an angle of 45 degrees, leaving the up-stream edges of the opening nearly sharp. This opening must be of sufficient length and depth to discharge all the water flowing in the stream; no water being allowed to flow over the top of the dam or underneath it while the measurement is being made.

The head or depth of flow of water over weir is the vertical distance from the crest to the surface of still water above the dam. To measure this head proceed as follows: In the bed of the stream at a distance of 4 to 6 feet from the dam on the up-stream side, drive a stake until its top is just level with the crest of weir; then alongside of this one drive another stake on which to mark the height of the surface of water when flowing over the finished weir. By means of a rule—one end resting on top of the first stake—measure the head or depth of flow in inches to the surface of water.

The length of the opening should be from three to ten times the head, and the vertical distance from the bottom of the opening to the bed of the stream should be at least two times the head. The sides of the opening should not approach the sides of the stream nearer than a distance equal to the head.

Having found the head or depth of flow, to find the quantity of water passing throug the weir in cubic feet per minute, refer to the table for weir dam measurement on the next page.

Find the quantity in cubic feet per minute corresponding to the depth of flow in inches and multiply it by the number of inches in length of the weir.

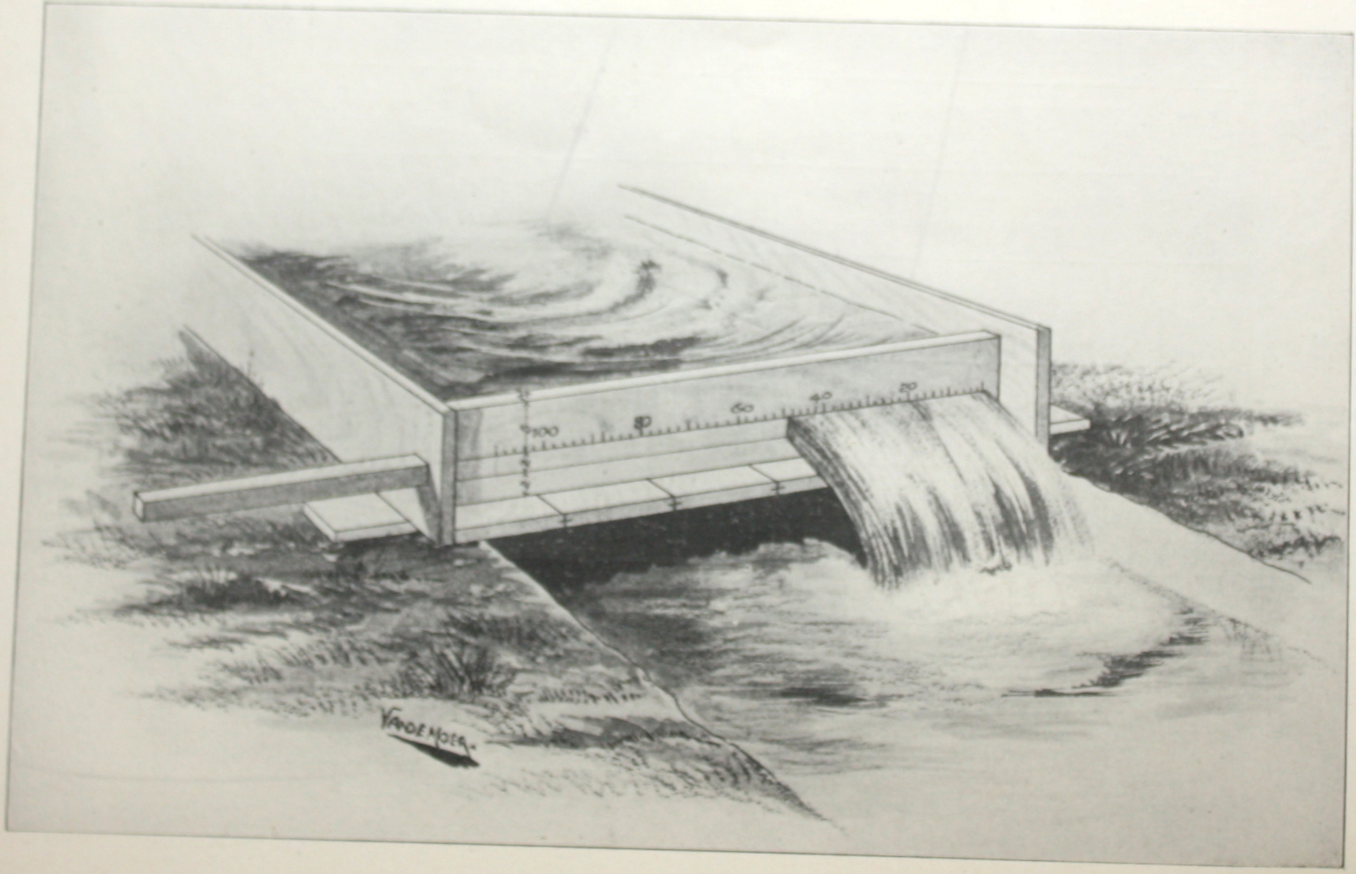
For example:

Suppose a weir is 48 inches long and the head or depth of flow over the crest is 10⅜ inches; find 10 inches in the table, then run across the table to the column under ⅜-inch; we find that 13.43 cubic feet per minute will flow over each inch in width of a weir under a head of 10⅜ inches; the quantity of water then that will flow over this weir is 13.43x48=644.64 cubic feet per minute.

FLOW OF WATER OVER WEIRS.

Table giving cubic feet of water per minute that will flow over one inch in width of a weir when the head of water over crest of weir is from ⅛ inch to 24⅞ inches.

		⅛ INCH.	¼ INCH.	⅜ INCH.	½ INCH.	⅝ INCH.	¾ INCH.	⅞ INCH.
INCHES	CUBIC FT.	CUBIC FT.	CUBIC FT.	CUBIC FT.	CUBIC FT.	CUBIC FT.	CUBIC FT.	CUBIC FT.
0		.01	.05	.09	.14	.20	.26	.33
1	.40	.47	.55	.65	.74	.83	.93	1.03
2	1.14	1.24	1.36	1.47	1.59	1.71	1.83	1.96
3	2.09	2.23	2.36	2.50	2.63	2.78	2.92	3.07
4	3.22	3.37	3.52	3.68	3.83	3.99	4.16	4.32
5	4.50	4.67	4.84	5.01	5.18	5.36	5.54	5.72
6	5.90	6.09	6.28	6.47	6.65	6.85	7.05	7.25
7	7.44	7.64	7.84	8.05	8.25	8.45	8.66	8.86
8	9.10	9.31	9.52	9.74	9.96	10.18	10.40	10.62
9	10.86	11.08	11.31	11.54	11.77	12.00	12.23	12.47
10	12.71	13.95	13.19	13.43	13.67	13.93	14.16	14.42
11	14.67	14.92	15.18	15.43	15.67	15.96	16.20	16.46
12	16.73	16.99	17.26	17.52	17.78	18.05	18.32	18.58
13	18.87	19.14	19.42	19.69	19.97	20.24	20.52	20.80
14	21.00	21.37	21.65	21.94	22.22	22.51	22.79	23.08
15	23.38	23.67	23.97	24.26	24.56	24.86	25.16	25.46
16	25.76	26.06	26.36	26.66	26.97	27.27	27.58	27.89
17	28.20	28.51	28.82	29.14	29.45	29.76	30.08	30.39
18	30.70	31.02	31.34	31.66	31.98	32.31	32.63	32.96
19	33.29	33.61	33.94	34.27	34.60	34.94	35.27	35.60
20	35.94	36.27	36.60	36.94	37.28	37.62	37.96	38.31
21	38.65	39.00	39.34	39.69	40.04	40.39	40.73	41.09
22	41.43	41.78	42.13	42.49	42.84	43.20	43.56	43.92
23	44.28	44.64	45.00	45.38	45.71	46.08	46.43	46.81
24	47.18	47.55	47.91	48.28	48.65	49.02	49.39	49.76


100
80
60
40
20

MINER'S INCH MEASUREMENT.

A Miner's Inch of water is a quantity that varies from 1⅓ cubic feet to 1¾ cubic feet per minute, depending upon the thickness of the board in which the aperture is made, upon the head of water above the center of the aperture, and upon the length and height of the aperture.

The Miner's Inch in general use, and as given in the Hug Water Wheel Table, is equivalent to a flow of 1½ cubic feet of water per minute, it represents the flow of water through each square inch of an aperture 2 inches high and of any required length, through a plank one and one quarter inches in thickness. The lower edge of the aperture is 2 inches above the bottom of the measuring box, and the top of the aperture plank which determines the head of water is 9 inches above the bottom of the box, making a 6 inch head above the centre of the stream. The fixed end of the aperture must be 2 inches from the side of the box to allow for contraction. The length of the opening is regulated by means of the sliding bars, the opening being closed until the surface of the water in the box is just level with the top of the aperture plank.

If the quantity of water is greater than can be measured through an opening 2 inches high of convenient length, use an aperture 4 inches high and increase the height of the plank 1 inch, thus making a 6 inch head above the centre of the aperture.

Showing the Discharge in Cubic Feet Per Minute of a Miner's Inch of Water as Measured Under the Various Heads and Different Lengths and Heights of Apertures Used in California.

Length of Opening in Inches.	Opening 2 Inches High.			Opening 4 Inches High.		
	Head to Cent'r 5 inches.	Head to Cent'r 6 Inches.	Head to Center 7 Inches	Head to Cent'r 5 Inches	Head to Cent'r 6 Inches.	Head to Center 7 Inches.
	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.	Cubic Feet.
4	1.348	1.473	1.589	1.320	1.450	1.570
6	1.355	1.480	1.596	1.336	1.470	1.595
8	1.359	1.484	1.600	1.344	1.481	1.608
10	1.361	1.485	1.602	1.349	1.487	1.615
12	1.363	1.487	1.604	1.352	1.491	1.620
14	1.364	1.488	1.604	1.354	1.494	1.623
16	1.365	1.489	1.605	1.356	1.496	1.626
18	1.365	1.489	1.606	1.357	1.498	1.628
20	1.365	1.490	1.606	1.359	1.499	1.630
22	1.366	1.490	1.607	1.359	1.500	1.631
24	1.366	1.490	1.607	1.360	1.501	1.632
26	1.366	1.490	1.607	1.361	1.502	1.633
28	1.367	1.491	1.607	1.361	1.503	1.634
30	1.367	1.491	1.608	1.362	1.503	1.635
40	1.367	1.492	1.608	1.363	1.505	1.637
50	1.368	1.493	1.609	1.364	1.507	1.639
60	1.368	1.493	1.609	1.365	1.508	1.640
70	1.368	1.493	1.609	1.365	1.508	1.641
80	1.368	1.493	1.609	1.366	1.509	1.641
90	1.369	1.493	1.610	1.366	1.509	1.641
100	1.369	1.494	1.610	1.366	1.509	1.642

FRICTION OF WATER IN PIPES

Table showing the velocity and discharge of water through straight, smooth, cylindrical cast iron pipes of different diameters; with the friction head required for each 100 feet in length of pipe. The friction head is that part of the total head that is required to overcome the friction of water flowing in the pipe; it represents the head that is lost by friction. The velocity head is the head that produces the velocity of water in the pipe; the velocity head remains the same for any length of pipe, it being dependent only on the velocity of water in the pipe.

INSIDE DIAMETER OF PIPE IN INCHES,

Velocity in Feet Per Second.	Velocity Head in Feet.	1		2		3		4		5		6	
		Friction head in Ft. per 100 Ft.	Cubic Ft. per Minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute
2.0	.062	1.98	.65	.983	2.61	.659	5.89	.494	10.4	.395	16.3	.329	23.5
2.2	.075	2.34	.72	1.170	2.88	.780	6.48	.585	11.5	.468	18.0	.390	25.9
2.4	.090	2.73	.78	1.366	3.14	.911	7.07	.683	12.5	.547	19.6	.456	28.2
2.6	.105	3.15	.85	1.576	3.40	1.05	7.65	.788	13.6	.631	21.3	.526	30.6
2.8	.122	3.60	.91	1.80	3.66	1.20	8.24	.900	14.6	.720	22.9	.600	32.9
3.0	.140	4.08	.98	2.04	3.92	1.35	8.83	1.02	15.7	.815	24.5	.679	35.3
3.2	.160	4.57	1.04	2.29	4.18	1.52	9.42	1.14	16.7	.915	26.2	.763	37.7
3.4	.180	5.10	1.11	2.55	4.45	1.70	10.0	1.27	17.8	1.02	27.8	.851	40.0
3.6	.202	5.66	1.17	2.83	4.71	1.89	10.6	1.41	18.8	1.13	29.4	.943	42.4
3.8	.225	6.24	1.24	3.12	4.97	2.08	11.2	1.56	19.9	1.25	31.0	1.04	44.7
4.0	.250	6.85	1.30	3.42	5.23	2.28	11.8	1.71	20.9	1.37	32.7	1.14	47.1
4.2	.275	7.48	1.37	3.74	5.49	2.49	12.3	1.87	22.0	1.50	34.3	1.25	49.5
4.4	.302	8.14	1.44	4.07	5.76	2.71	12.9	2.03	23.0	1.63	36.0	1.35	51.8
4.6	.330	8.83	1.50	4.42	6.02	2.94	13.5	2.21	24.0	1.76	37.6	1.47	54.1
4.8	.360	9.54	1.57	4.77	6.28	3.18	14.1	2.38	25.1	1.91	39.2	1.59	56.5
5.0	.390	10.29	1.63	5.14	6.54	3.43	14.7	2.57	26.2	2.05	40.9	1.71	58.9
5.2	.422	11.04	1.70	5.52	6.80	3.68	15.3	2.76	27.2	2.21	42.5	1.84	61.2
5.4	.455	11.84	1.76	5.92	7.07	3.94	15.9	2.96	28.2	2.37	44.2	1.97	63.6
5.6	.490	12.66	1.83	6.33	7.33	4.22	16.5	3.16	29.3	2.53	45.8	2.11	65.9
5.8	.525	13.50	1.90	6.75	7.59	4.50	17.1	3.37	30.3	2.70	47.4	2.25	68.3
6.0	.562	14.36	1.96	7.18	7.85	4.78	17.7	3.59	31.4	2.87	49.1	2.39	70.7
6.2	.600	15.24	2.02	7.62	8.11	5.08	18.2	3.81	32.4	3.05	50.7	2.54	73.0
6.4	.640	16.16	2.09	8.08	8.38	5.39	18.8	4.04	33.5	3.23	52.3	2.69	75.4
6.6	.680	17.12	2.16	8.56	8.64	5.70	19.4	4.28	34.5	3.42	54.0	2.85	77.7
6.8	.722	18.08	2.22	9.04	8.90	6.02	20.0	4.52	35.6	3.61	55.6	3.01	80.1
7.0	.765	19.08	2.29	9.54	9.16	6.35	20.6	4.77	36.6	3.81	57.2	3.18	82.4

INSIDE DIAMETER OF PIPE IN INCHES.

Velocity in Feet per Second	Velocity Head in Feet	7		8		9		10		11		12	
		Friction head in Ft. per 100 Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Fric-Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute
2.0	.062	.282	32.0	.247	41.9	.220	53.0	.198	65.4	.180	79.2	.165	94.2
2.2	.075	.334	35.3	.293	46.1	.260	58.3	.234	72.0	.213	87.1	.195	103.
2.4	.090	.390	38.5	.342	50.2	.304	63.6	.273	78.5	.248	95.0	.228	113.
2.6	.105	.450	41.7	.394	54.4	.350	68.9	.315	85.1	.287	103.	.263	122.
2.8	.122	.514	44.9	.450	58.6	.400	74.2	.360	91.6	.327	111.	.300	132.
3.0	.140	.582	48.1	.509	62.8	.453	79.5	.407	98.2	.370	119.	.339	141.
3.2	.160	.654	51.3	.572	67.0	.508	84.8	.458	105.	.416	127.	.381	151.
3.4	.180	.729	54.5	.638	71.2	.567	90.1	.510	111.	.464	134.	.425	160.
3.6	.202	.808	57.7	.707	75.4	.629	95.4	.566	118.	.514	142.	.472	169.
3.8	.225	.892	60.9	.780	79.6	.693	101.	.624	124.	.567	150.	.520	179.
4.0	.250	.979	64.1	.856	83.7	.761	106.	.685	131.	.623	158.	.571	188.
4.2	.275	1.07	67.3	.935	87.9	.832	111.	.748	137.	.680	166.	.624	198.
4.4	.302	1.16	70.5	1.02	92.1	.905	116.	.814	144.	.740	174.	.679	207.
4.6	.330	1.26	73.7	1.10	96.3	.981	122.	.883	150.	.803	182.	.736	217.
4.8	.360	1.36	76.9	1.19	100.	1.06	127.	.954	157.	.867	190.	.795	226.
5.0	.390	1.47	80.2	1.28	105.	1.14	132.	1.03	163.	.935	198.	.857	235.
5.2	.422	1.58	83.3	1.38	109.	1.23	138.	1.10	170.	1.00	206.	.920	245.
5.4	.455	1.69	86.6	1.48	113.	1.31	143.	1.18	177.	1.07	214.	.986	254.
5.6	.490	1.81	89.8	1.58	117.	1.40	148.	1.26	183.	1.15	222.	1.05	264.
5.8	.525	1.93	93.0	1.68	121.	1.50	154.	1.35	190.	1.22	229.	1.12	273.
6.0	.562	2.05	96.2	1.79	125.	1.59	159.	1.43	196.	1.30	237.	1.19	283.
6.2	.600	2.18	99.4	1.90	130.	1.69	164.	1.52	203.	1.38	245.	1.27	292.
6.4	.640	2.31	102.	2.02	134.	1.79	169.	1.61	209.	1.47	253.	1.35	301.
6.6	.680	2.44	106.	2.14	138.	1.90	175.	1.71	216.	1.55	261.	1.42	311.
6.8	.722	2.58	109.	2.26	142.	2.01	180.	1.81	222.	1.64	269.	1.50	320.
7.0	.765	2.72	112.	2.38	146.	2.12	185.	1.90	229.	1.73	277.	1.59	330.

CAUTION:—The friction heads in this table are given for cast iron pipe in good order. For riveted pipe the friction head should be increased 20 per cent.

FRICTION OF WATER IN PIPES

INSIDE DIAMETER OF PIPE IN INCHES.

Velocity in Feet Per Second.	Velocity Head in Feet.	13		14		15		16		18		20	
		Friction head in Ft. per 100 Ft.	Cubic Ft. per Minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute
2.0	.062	.152	110	.141	128	.132	147	.123	167	.110	212	.099	262
2.2	.075	.180	121	.167	141	.156	162	.146	184	.130	233	.117	288
2.4	.090	.210	133	.195	154	.182	176	.171	201	.152	254	.137	314
2.6	.105	.242	144	.225	167	.210	191	.197	218	.175	275	.158	340
2.8	.122	277	156	.257	179	.240	206	.225	234	.200	297	.180	366
3.0	.140	.313	166	.291	192	.271	221	.255	251	.226	318	.204	393
3.2	.160	.352	177	.327	205	.305	235	.286	268	.254	339	.229	419
3.4	.180	.393	188	.365	218	.340	250	.319	284	.283	360	.255	445
3.6	.202	.435	199	.404	231	.377	265	.354	301	.314	382	.283	471
3.8	.225	.480	210	.446	243	.416	280	.390	318	.347	403	.312	497
4.0	.250	.527	221	.489	256	.457	294	.428	335	.380	424	.342	523
4.2	.275	.576	232	.534	269	.499	309	.468	352	.416	445	.374	550
4.4	.302	.626	243	.582	282	.543	324	.509	368	.452	466	.407	576
4.6	.330	.679	254	.631	295	.589	339	.552	385	.490	488	.441	602
4.8	.360	.734	265	.682	308	.636	353	.596	402	.530	509	.477	628
5.0	.390	.791	276	.734	321	.685	368	.642	419	.571	530	.514	654
5.2	.422	.850	287	.789	333	.736	383	.690	435	.614	551	.552	680
5.4	.455	.910	298	.845	346	.789	397	.740	452	.657	572	.592	707
5.6	.490	.973	309	.903	359	.843	412	.791	469	.703	594	.632	733
5.8	.525	1.04	321	.964	372	.899	427	.843	486	.749	615	.674	759
6.0	.562	1.10	332	1.02	385	.957	442	.897	502	.798	636	.718	785
6.2	.600	1.17	343	1.09	397	1.01	456	.953	519	.847	657	.762	811
6.4	.640	1.24	354	1.15	410	1.08	471	1.01	536	.898	678	.808	838
6.6	.680	1.31	365	1.22	423	1.14	486	1.07	553	.950	700	.855	864
6.8	.722	1.39	376	1.29	436	1.20	500	1.13	569	1.00	721	.904	890
7.0	.765	1.46	387	1.36	449	1.27	515	1.19	586	1.06	742	.953	916

INSIDE DIAMETER OF PIPE IN INCHES.

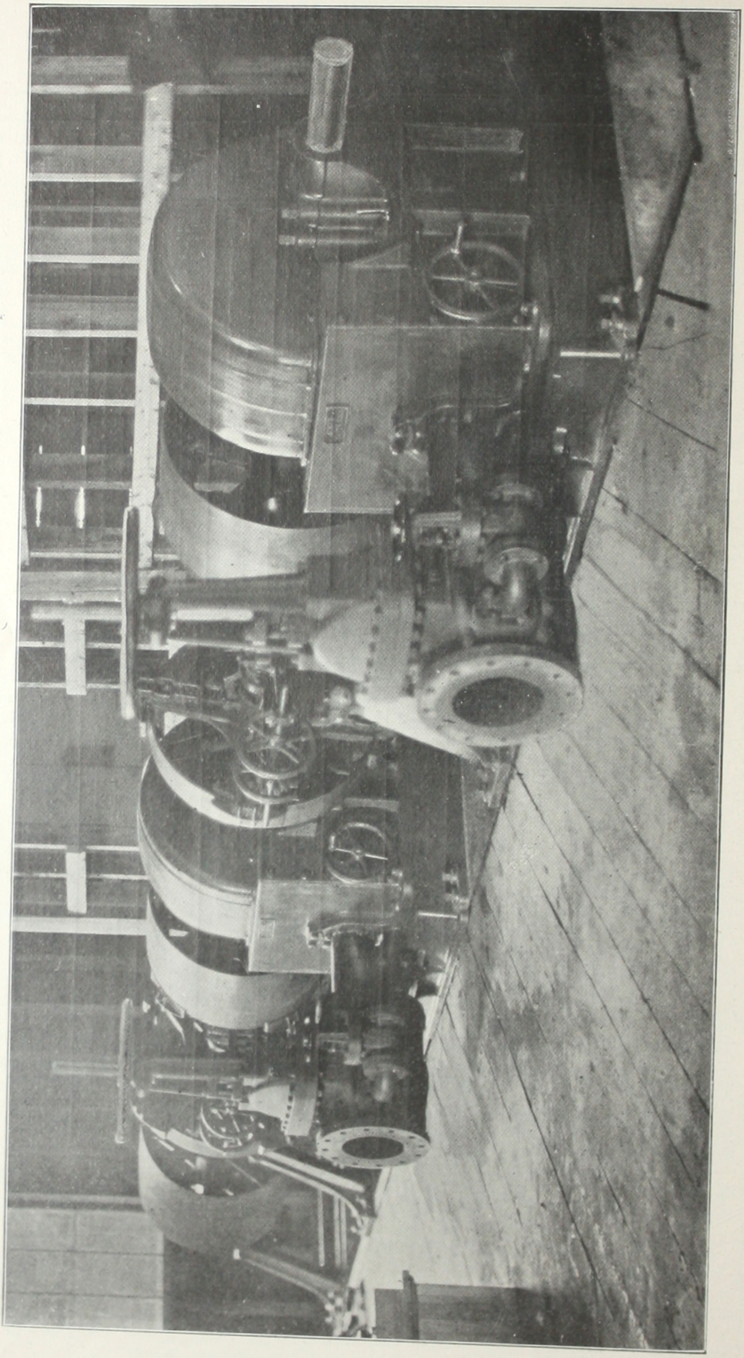
Velocity in Feet per Second	Velocity Head in Feet	22		24		26		28		30		36	
		Friction head in Ft. per 100 Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Fric- Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute	Friction Head in Ft.	Cubic Ft. per minute
2.0	.062	.090	316	.082	377	.076	442	.070	513	.066	589	.055	848
2.2	.075	.106	348	.097	414	.090	486	.083	564	.078	648	.065	933
2.4	.090	.124	380	.114	452	.105	531	.097	616	.091	707	.076	1017
2.6	.105	.143	412	.131	490	.121	575	.112	667	.105	766	.088	1102
2.8	.122	.164	443	.150	528	.138	619	.128	718	.120	824	.100	1187
3.0	.140	.185	475	.170	565	.157	663	.145	770	.136	883	.113	1272
3.2	.160	.208	507	.191	603	.176	708	.163	821	.152	942	.127	1357
3.4	.180	.232	538	.213	641	.196	752	.182	872	.170	1001	.142	1442
3.6	.202	.257	570	.236	678	.218	796	.202	923	.189	1060	.157	1527
3.8	.225	.284	601	.260	716	.240	840	.223	974	.208	1119	.173	1611
4.0	.250	.311	633	.285	754	.263	885	.244	1026	.228	1178	.190	1696
4.2	.275	.340	665	.312	791	.288	929	.267	1077	.249	1237	.208	1781
4.4	.302	.370	697	.339	829	.313	973	.290	1129	.271	1296	.226	1866
4.6	.330	.401	728	.368	867	.339	1017	.315	1180	.294	1355	.245	1951
4.8	.360	.434	760	.397	905	.367	1062	.341	1231	.318	1414	.265	2036
5.0	.390	.467	792	.428	942	.395	1106	.367	1283	.343	1472	.285	2120
5.2	.422	.502	823	.460	980	.425	1150	.394	1334	.368	1531	.307	2205
5.4	.455	.538	855	.493	1018	.455	1194	.423	1385	.394	1590	.328	2290
5.6	.490	.575	887	.527	1055	.486	1239	.452	1437	.422	1649	.351	2375
5.8	.525	.613	918	.562	1093	.519	1283	.482	1488	.450	1708	.375	2460
6.0	.562	.652	950	.598	1131	.552	1327	.513	1539	.478	1767	.399	2544
6.2	.600	.693	982	.635	1168	.586	1371	.544	1590	.508	1826	.423	2629
6.4	.640	.735	1013	.673	1206	.622	1416	.577	1642	.539	1885	.449	2714
6.6	.680	.778	1045	.713	1244	.658	1460	.611	1693	.570	1943	.475	2799
6.8	.722	.821	1077	.753	1282	.695	1504	.645	1744	.602	2003	.500	2884
7.0	.765	.867	1109	.794	13[illegible]	.733	1548	.681	1796	.635	2061	.530	2969

CAUTION:—The friction heads in this table are given for cast iron pipe in good order. For riveted pipe the friction head should be increased 20 per cent.

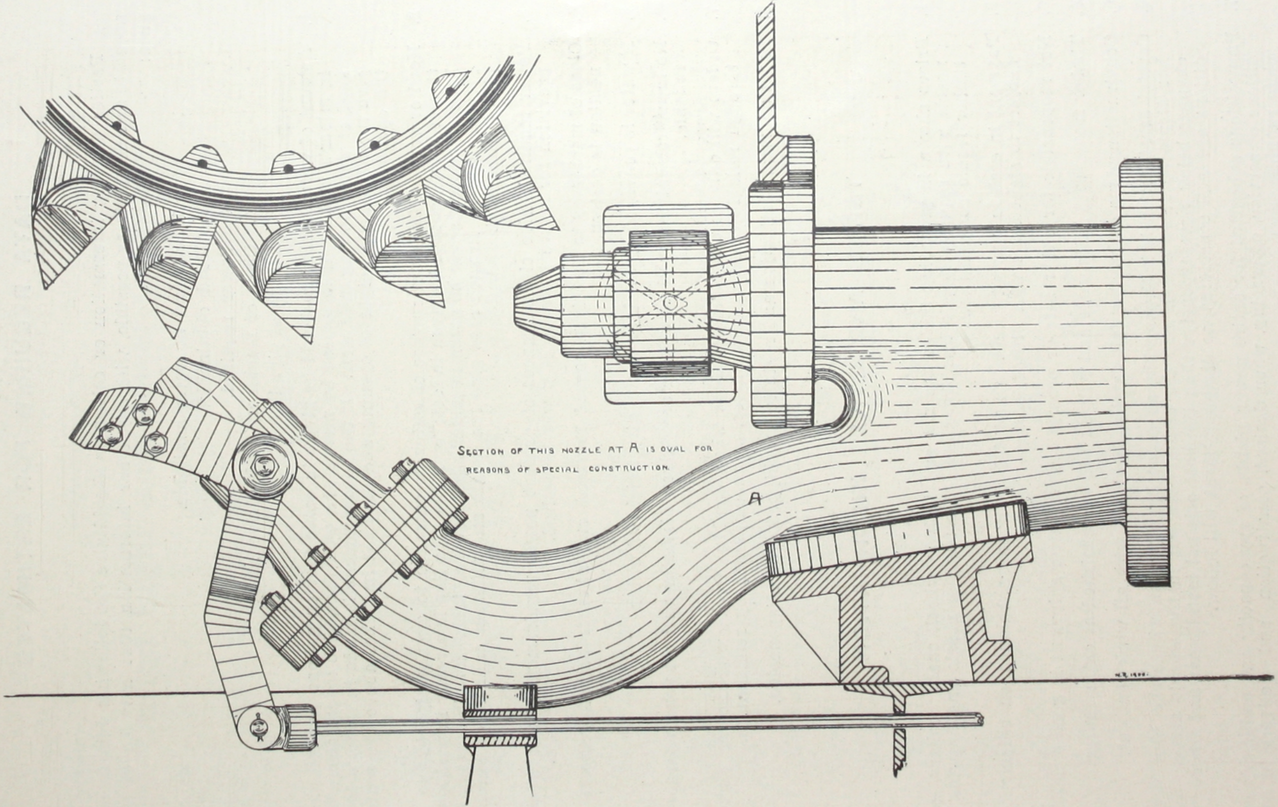
EXAMPLE.—What head is necessary to overcome friction of water in 800 feet of 26-inch diameter cast iron pipe delivering 1,150 cubic feet of water per minute, the pipe being in good condition?

In the table, under 26-inch pipe, the friction head corresponding to a discharge of 1,150 cubic feet per minute is found to be .425 feet per 100 feet of pipe; and for 800 feet of pipe the friction head will be 8 times .425=3,400 feet.

The velocity of water in the pipe is 5.2 feet per second, requiring a velocity head of .422 feet. What total head of water would be necessary to maintain an effective head of 200 feet? Answer: 200+3.400+.422=203.82 feet.



Hug Water Wheels and Extension for connection with Corliss Engine, so arranged that any part of it can be cut ont while running.
As in operation in Electric Light and Power Plant, at Georgetown, Colorado.


SECTION OF THIS NOZZLE AT A IS OVAL FOR REASONS OF SPECIAL CONSTRUCTION.
A

Double nozzle with tip valve and cut off head, as used in Electric Light and Power Plant at Georgetown, Colorado.

DATA REQUIRED FOR ESTIMATES

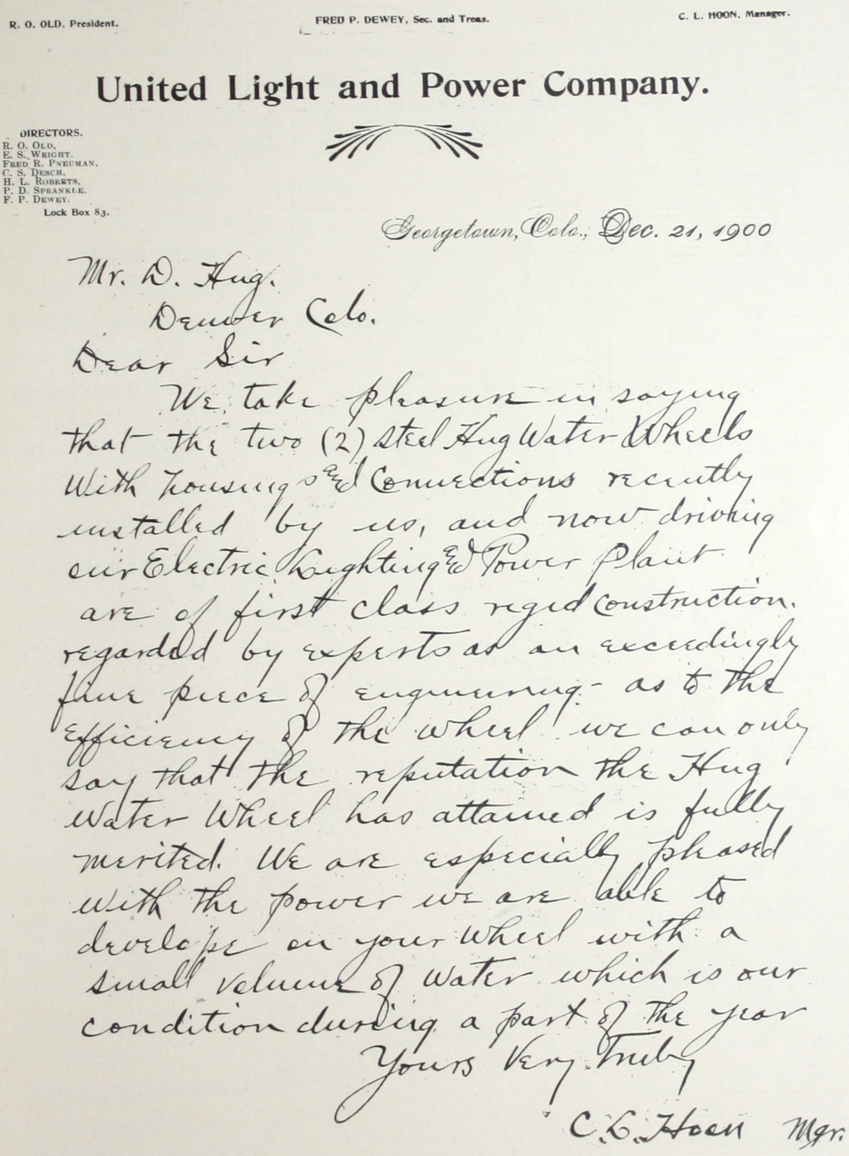
Parties desiring information or estimates should give the following data as nearly accurate and complete as possible, with any other information that may be of assistance:

1. Amount of water available.
2. Head obtainable.
3. Power required.
4. Class of machinery to be driven.
5. Length of pipe line.

1. Amount of water available should be given in cubic feet or gallons per minute; or in miner's inches. If measured by means of a weir dam, give length of crest and head of water flowing over weir. If the measurement is made in miner's inches, give the length and height of opening and the head in inches above the center of the opening.
2. Head or vertical fall from surface of water at entrance to supply pipe to the location of wheel, should be given in feet; or if the pipe line is already in position the head or pressure may be given in pounds per square inch, as indicated by a pressure gauge. In such case give the length and different calibers of which the pipe is composed.
3. Power required—give circumstances of present power requirements and state if provision for future increase of power is desired.
4. Class of machinery to be driven—speed required, and whether belted or direct connection is desired.
5. If water is conveyed by ditch or flume, give height of water.
6. No measurement that a piece of pipe of a given diameter will convey the water, is reliable.
7. Orders will only be considered as such when coming from well-known persons, through reliable commercial agencies, or accompanied by remittances.
8. Exact address, destination and route to be shipped are indispensable.

TERMS AND OTHER INFORMATION

1. Prices shown in preceding tables are net and include wheel, shaft, collars, gate, nozzle with required nozzle tips, template for setting of nozzle and drawing for timber frame construction.
2. Payment in cash in current funds. One-third with order, balance on shipment or subject to sight draft with bill of lading.
3. Not responsible for either safe or prompt delivery after shipment in good condition.
4. Timber frame with bolts, rods and pulleys will be furnished at extra charge.
5. Construction plans embracing full details, furnished with all work sent out.
6. Careful construction is indispensable, as cases have proven where the Hug Wheel has displaced other wheels and the faults were not in the wheels alone. Such changes being more expensive than the best original installment and where conditions are well considered no disappointment will follow.
7. Propositions submitted for entire power plants, of any capacity and under any conditions of service, embracing, when desired, construction and delivery in complete running order.



R. O. OLD, President. FRED P. DEWEY, Sec. and Treas. C. L. HOON, Manager.

United Light and Power Company.

DIRECTORS.
R. O. OLD,
E. S. WRIGHT,
FRED R. PNEUMAN,
C. S. DESCH,
H. L. ROBERTS,
P. D. SPRANKLE,
F. P. DEWEY.
Lock Box 83.

Georgetown, Colo., Dec. 21, 1900

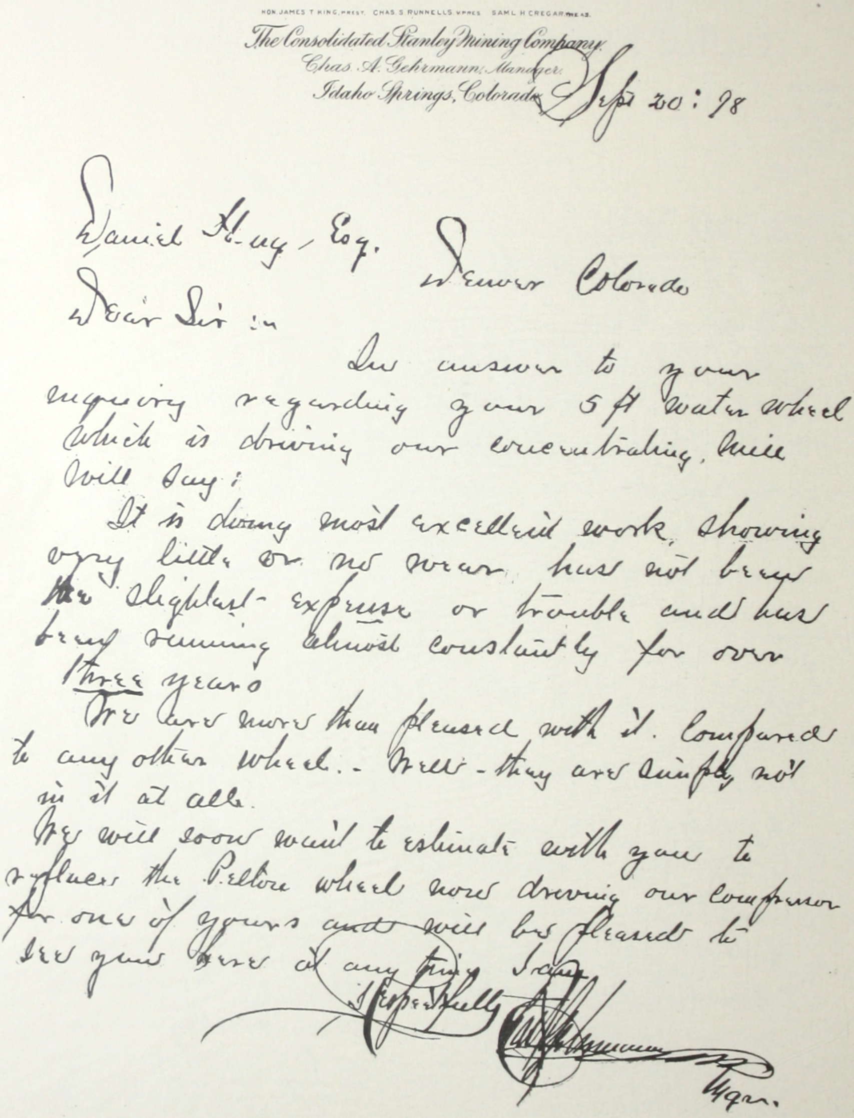
Mr. D. Hug.
Denver Colo.

Dear Sir

We take pleasure in saying that the two (2) Steel Hug Water Wheels With housings & Connections recently installed by us, and now driving our Electric Lighting & Power plant. are of first class rigid construction. regarded by experts as an exceedingly fine piece of engineering - as to the Efficiency of the wheel we can only say that the reputation the Hug Water Wheel has attained is fully merited. We are especially pleased with the power we are able to develope on your Wheel with a small volume of water which is our condition during a part of the year

Yours Very Truly

C. L. Hoon Mgr.



HON. JAMES T. KING, PREST. CHAS. S. RUNNELLS, V.PRES. SAML. H. CREGAR, TREAS.
The Consolidated Stanley Mining Company.
Chas. A. Gehrmann, Manager.
Idaho Springs, Colorado

Sept 20 : 98

Daniel Hug, Esq.
Denver Colorado

Dear Sir:

In answer to your enquiry regarding your 5 ft water wheel which is driving our concentrating mill will say:

It is doing most excellent work, showing very little or no wear, has not been the slightest expense or trouble and has been running almost constantly for over three years.

We are more than pleased with it. Compared to any other wheel. - Well - they are simply not in it at all.

We will soon want to estimate with you to replace the Pelton wheel now driving our compressor for one of yours and will be pleased to see you here at any time. I am

Respectfully

Mgr.

REFERENCES

Wm. Story	Ouray, Colo.	1
Hollenbeck & Meachem	Salida, Colo.	1
Empress Mining & Milling Co	Empire, Colo.	1
Mt. Albert Gold Mining, Milling & Tunnel Co	Lake City, Colo.	1
Zavaleta Limited Mining Co	Mexico.	1
Colorado Ore Sampling & Reduction Co	Colorado.	2
E. Cherest Gold Exploration Co	Bolivia.	1
Woody Mining & Milling Co	Colorado.	1
Montgomery Machinery Co	Colorado.	1
Cosmos Tunnel Co.	Ellwood, Colo.	2
Ault Wiborg	Frisco, Colo.	1
Bella Vista Mining Co	Puntas Arenas, Costa Rica.	1
J. L. Truckart	Ameca, Mexico.	1
Pennsylvania Mines Co	Montezuma, Colo.	3
Hunters Pass Mine	Aspen, Colo.	1
James Moynahan	Alma, Colo.	1
Lion Group Mining Co	Eureka, Colo.	1
Bachelor Mining Co.	Lake City, Colo.	1
Hermit Lake Copper Mining Co	Silver Cliff, Colo.	2
Aztec Gold Mining Co	Middleton, Colo.	1
Sunny Side Mine	Eureka, Colo.	1
George R. Stewart	Yankee, Colo.	1
Lucky Strike Gold Mining Co	Gunnison, Colo.	1
T. C. Dobbins	Telluride, Colo.	2
E. C. Conditt	Eureka, Colo.	1
Leopold Kocbis	Cheyenne, Wyo.	2
Ernest Le Neve Foster	Denver, Colo.	3
Dr. Pantiss	Denver, Colo.	1
Standard Bottling Works	Denver, Colo.	1
H. A. Elliott	Idaho Springs, Colo.	1
Sunset Mining Co.	Minacoa Chia., Mex.	1
Unity Church	Denver, Colo.	1
Bateman Hardware Co.	Salida, Colo.	2
United Light and Power Co	Georgetown, Colo.	2
Leslie Copper Mining Co	Sohon Spur, Mont.	1

TELEGRAPHIC CODE FOR HUG WATER WHEEL.

Relating to diameter of wheel without iron casing and protectors, such as include: Wheel, shaft, nozzle, boxes, collars, three tips and gate.

3 ft. wheel	Aha	6 "	Arata
4 "	Alla	7 "	Affia
5 "	Akia	8 "	Acha

Wheels of small size are always full cased in cast iron and called motors.

6 in. wheel	Ba	20 "	Baffara
12 "	Baca	24 "	Bagdad
18 "	Baden		

Two nozzle wheels.

3 ft. wheel	Cadiz	6 "	Caicos
4 "	Cahir	7 "	Cairo
5 "	Cahors	8 "	Calais

DENOTING FALL. (HEAD)

10	Dahl	350	Dover	690	Elmira
20	Dakotah	360	Doof	700	Elposa
30	Dalles	370	Dream	710	Emesa
40	Dalton	380	Drin	720	England
50	Danube	390	Dromore	730	Epernay
60	Darien	400	Drusus	740	Erfurt
70	Darwar	410	Dublin	750	Erin
80	Decatur	420	Duur	760	Erlan
90	Delagoa	430	Dubois	770	Escurial
100	Delgoda	440	Dubec	780	Etna
110	Delvino	450	Duero	790	Europe
120	Demboa	460	Duisburg	800	Falaise
130	Desoto	470	Dulce	810	Falkirk
140	Detmold	480	Dunbar	820	Falkenhof
150	Detroit	490	Dunder	830	Fano
160	Deva	500	Dundo	840	Faro
170	Deventer	510	Dunda	850	Fauquier
180	Dieppe	520	Dunga	860	Fagal
190	Dijon	530	Dunkeld	870	Fayette
200	Dinant	540	Dunkirk	880	Fermoy
210	Dizier	550	Durance	890	Ferrara
220	Doal	560	Durango	900	Ferro
230	Dole	570	Durazzo	910	Ferrol
240	Domingo	580	Duval	920	Ferin
250	Dominica	590	Durham	930	Finland
260	Doncastor	600	Duren	940	Fiume
270	Dongola	610	Earn	950	Florence
280	Donegal	620	Ebora	960	Florida
290	Dordrecht	630	Ebro	970	Fondi
300	Dort	640	Eccloe	980	Fontius
310	Dorper	650	Ecuador	990	Formosa
320	Douai	660	Edina	1000	France
330	Doubs	670	Edinto	2000	Frozolone
340	Doura	680	Elbeuf		

RELATING TO HORSE POWERS.

1	Adriatic
2	**Albania**
3	Alcala
4	Alhambra
5	Alsace
6	Amazon
7	America
8	Amiens
9	Amoy
10	Anatolia
15	Ancoua
20	Andalusia
30	Andes
40	Antigua
50	Antwerp
60	Ardennes
70	Arizona
80	Arles
90	Arras
100	Asia
110	Arve
120	Asturia
130	Athens
140	Atlantic
150	Atlas
160	Attica
170	Aukland
180	Australia
190	Autunda
200	Auvergne
210	Azores
220	Africa
230	Bale
240	Baltic
250	Bangor
260	Barbary
270	Batavia
280	Baton
290	Bavaria
300	Bermudaz
310	Bern
320	Bohemia
330	Bokhara
340	Bolivia
350	Bombay
360	Borneo
370	Boston
380	Botany?
390	Brabant
400	Brazil
410	Bristol
420	Brugge
430	Bruin
440	Bucharest
450	Buda
460	Bulgarye
470	Burgos
480	Bordean
490	Balyn
500	Balaclava
600	Baltimore
700	Balmoral
800	Balzac
900	Baljongen
1000	Baljuw
2000	Baloor

RELATING TO WATER SUPPLY.

Water at lowest	Abalus
Water at maximum	Abartis
Average supply	Abaris
What is your minimum?	Abas
State quantity of water in square inches over weir dam?	Abatos
State quantity of water in square dec i meters over weir dam	Abia
Can you obtain more water?	Aboras
Can you increase head?	Abron

AMOUNT OF WATER IN SQUARE INCHES AS MEASURED IN WEIR.

5	Carbaras
10	Cabell
15	Cabrera
20	Caen
25	Caldas
30	Calder
35	Calicut
40	Calne
45	Cambag
50	Cambria
55	Cambridge
60	Campo
65	Canada
70	Canara
75	Candia
80	Cannes
85	Canon
90	Cantal
95	Canton
100	Cape
110	Capo
120	Capri
130	Capua
140	Caracas
150	Caraman
160	Cardenas
170	Cardiff
180	Cardona
190	Cariaco
200	Carlsbad
210	Carnatie
220	Carrara
230	Carrik
240	Cartago
250	Casal
260	Caobin
270	Caserta
280	Caspian
290	Cassel
300	Castel
310	Castile
320	Castine
330	Castle bar
340	Castre
350	Castro
360	Catania
370	Catean
380	Categat
390	Catorre
400	Cattaro
410	Caubul
420	Caucasm
430	Cavas
440	Cavan
450	Cavery
460	Cawpore
470	Caxias
480	Cayenne
490	Carel
500	Ceave
510	Cebu
520	Cecil
530	Cefalu
540	Celle
550	Cenis
560	Ceram
570	Cerigo
580	Cervia
590	Cesena
600	Censa
610	Ceylon
620	Chalons

AMOUNT OF WATER IN SQUARE INCHES AS MEASURED IN WEIR.—CONTINUED.

630	Charcas
640	Chartres
650	Chatean
660	Ciara
670	Cimaron
680	Cinaloa
690	Cintra
700	Circar
710	Circassia
720	Ciren
730	Cittadell
740	Cindad
750	Civita
760	Clermont
770	Clevel
780	Clonville
790	Coapoliet
800	Coango
810	Cobleur
820	Cobu
830	Coburg
840	Codorus
850	Cognoc
860	Cohoes
870	Coimbra
880	Coire
890	Colima
900	Colne
910	Cologne
920	Colombo
930	Colonsa
940	Comac
950	Comorin
960	Comoro
970	Concan
980	Concord
990	Conde
1000	Congo
1100	Coos
1200	Corbean
1300	Corbeil
1400	Cordora
1500	Corea
1600	Corpus
1700	Corpu
1800	Corsica
1900	Cotona
2000	Cotopasi
3000	Crema
4000	Crimea
5000	Culm

MINER'S INCHES.

5	Gadanus
10	Gaeta
15	Gaillac
20	Galaz
25	Galena
30	Galicia
35	Galway
40	Gambia
45	Gano
50	Gap
55	Gard
60	Garden
65	Gaspe
70	Geel
75	Genera
80	Genil
85	Genoa
90	Gera
95	Gerona
100	Gers
10	Gex
20	Ghent
30	Giguac
40	Gihon
50	Gironde
60	Glasgon
70	Glaz
80	Glogan
90	Gmund
200	Golconda
10	Gomeras
20	Gondar
30	Gotha
40	Gonda
50	Gogar
60	Gozzo
70	Gracias
80	Graetz
90	Granida
300	Grasse
10	Gratiot
20	Grans
30	Grenoble
40	Grese
50	Grison
60	Gross
70	Groton
80	Guarda
90	Guagea
400	Guben
10	Guiana
20	Guinea
30	Guise
40	Gurwal
50	Gustron
60	Gwalior
70	Gugla
80	Habana
90	Hague
500	Hainaull
10	Haiti
20	Halele
30	Halifan
40	Hall
50	Honean
60	Hang
70	Hanover
80	Haarlem
90	Hartz
600	Hatteras
10	Havana
20	Havre
30	Hecla
40	Helena
50	Heral
60	Hermes
70	Hesse
80	Hindoo
90	Hindostan
700	Holland
10	Holmes
20	Holotein
30	Holston
40	Homburg
50	Homs
60	Honan
70	Honda
80	Honduras
90	Honplene
800	Honiton
10	Houssa
20	Houston
30	Hue
40	Huelva
50	Huerba
60	Huesca
70	Hungry
80	Hurd
90	Huron
900	Huy
10	Hurra
20	Iceland
30	Idaho
40	Idia
50	Iglan
60	Illinois
70	Imola
80	India
90	Indostan
1000	Indus
1100	Iona
1200	Iowa
1300	Ireland
1400	Iroquois
1500	Irvine
1600	Ischia
1700	Ierseke
1800	Iser
1900	Iserlohn
2000	Isis
3000	Isla
4000	Isle
5000	Ismael

AMOUNT OF WATER IN CUBIC DECEMITRES PER MINUTE.

20	Cabot
40	Caboul
50	Caeus
60	Cadets
70	Cadillas
80	Caffa
90	Cahors
100	Caille
200	Caire

300	Cajare
400	Calabar
500	Calel
600	Calepino
700	Calicut
800	Caligula
900	Calinte
1000	Callac
2000	Callas

3000	Calmar
4000	Calmet
5000	Calpe
6000	Calvin
7000	Canibon
8000	Camerino
9000	Camille
10000	Canovas

AMOUNT OF WATER IN CUBIC FEET PER MINUTE.

5	Abalus
10	Abantes
15	Abaris
20	Abas
25	Abassa
30	Abatos
35	Abdalon
40	Abdera
45	Abderus
50	Abella
55	Abia
60	Abila
65	Abnoba
70	Aboras
75	Abron
80	Abrota
85	Abydus
90	Abyla
95	Acacius
100	Acamas
10	Acron
20	Arojohs
30	Actoris
40	Acra
50	Acratus
60	Actia
70	Actium
80	Adamas
90	Addua
200	Admete
10	Adonia
20	Adrana
30	Adula
40	Acdon
50	Aolis
60	Aora
70	Apytus
80	Aqui
90	Asopus
300	Abolia

10	Agamas
20	Agorus
30	Agave
40	Agenor
50	Albanus
60	Albia
70	Albini
80	Albiona
90	Albula
400	Aleanda
10	Alce
20	Alcides
30	Alca
40	Alecto
50	Alesa
60	Alex
70	Alexos
80	Alexis
90	Aloa
500	Alope
10	Alos
20	Alyba
30	Amanus
40	Amardi
50	Amas
60	Amata
70	Ambrosia
80	Amelso
90	Amida
600	Anasis
10	Anele
20	Andia
30	Anema
40	Anetor
50	Anglia
60	Anigrys
70	Anius
80	Annalus
90	Annibal
700	Anteros

10	Antir
20	Antia
30	Antiope
40	Anubus
50	Angelus
60	Aon
70	Aoris
80	Aorim
90	Apama
800	Appella
10	Aper
20	Apia
30	Apina
40	Apion
50	Apis
60	Apollo
70	Aptera
80	Apulia
90	Aquilo
900	Aquinas
10	Arabia
20	Aradus
30	Arbela
40	Arcadia
50	Arcanum
60	Ardalus
70	Ardea
80	Ardone
90	Arene
1000	Arrest
2000	Areta
3000	Areus
4000	Argia
5000	Argolis
6000	Aria
7000	Arion
8000	Aris
9000	Arnto
10000	Asch

DIAMETER OF PIPE IN INCHES.

INCH	
1	Ladoga
2	Lago
3	Laguna
4	Lahn
5	Lahore
6	Lahia
7	Laland
8	Lania
9	Landaner
10	Landes

11	Langres
12	Laon
13	Laredo
14	Larissa
15	Larnica
16	Lassa
17	Laubon
18	Laval
19	Lavora
20	Livorna

21	Leipsio
22	Leiria
23	Leitrum
24	Lena
25	Lenoir
26	Lentine
27	Leon
28	Lerida
29	Levant
30	Lieht

LENGTH OF PIPE LINE IN FEET.

FEET					
100	Maas	800	Malden	8000	Marin
125	Macao	900	Malmo	9000	Marion
150	Macomb	1000	Manaar	10000	Marne
175	Macaan	1500	Mancha	11000	Moroco
200	Macon	2000	Mandingo	12000	Maros
225	Madeira	2500	Manheim	13000	Mazzala
250	Madras	3000	Manilla	14000	Masua
275	Madrid	3500	Mans	15000	Matapan
300	Madura	4000	Mantua	16000	Mana
400	Mahon	4500	Maragon	17000	Mayo
500	Maida	5000	Marburg	18000	Melos
600	Main	6000	Mardin	19000	Melm
700	Malawa	7000	Mariel	20000	Melchior

GENERAL INFORMATION.

Your advice for a wheel to give......h. p. under head?	Nab
You need a larger wheel to give power demanded under head given	Nabob
More water or increased head will give it	Nacre
There is not head enough for water at command to give power desired	Nadir
Will need special wheel for full efficiency	Naiad
Double nozzle is necessary	Nair
Tripple nozzle is required	Name
Single nozzle will be ample	Narcotic
Give a clear statement as to quantity of water, head and length of pipe	Narol
Fill our order according to your best judgment	Natal
Advise a full cased wheel	Narcis
Advise a full cased wheel with governor	Natant
Would advise a wheel mounted on wood frame	Nation
Letter with instructions under way	Native
Will send engineer if desired at..........dollars per day and expenses	Natron
Send engineer on terms stated by you, he to report to	Natwater
Can you send a competent engineer, how soon, on what terms?	Naval

FOR ORDERING.

Enter order for........wheel under........ft. head, according to catalogue	Menai
Enter order for wheel under........head to make..........h. p	Mendo
Make for transportation by mule	Mentz
Execute order with all possible speed	Merida
Send full cased wheel	Messina
Send full cased wheel with governor	Mexico
Send all iron work for wood frame mounting,	Miaci
Send wood frame with all requirements	Micona
Send shaft..........feet long..........inch diameter	Milan
Send pulley.........inches diameter............inches face	Mincio
Send extra buckets for............waterwheel	Mogol

Example :—

Send five extra buckets for five foot waterwheel. Execute order with all possible speed..Mogol Akia Merida.

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